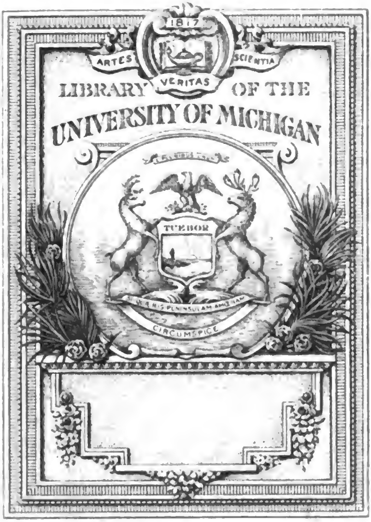
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patent inventions

ARTS, MANUFACTURES,

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AND

AGRICULTURE.

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ORIGINAL COMMUNICATIONS,

SPECIFICATIONS OF PATENT INVENTIONS,

PRACTICAL AND INTERESTING PAPERS,

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THE PHILOSOPHICAL TRANSACTIONS AND

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AND

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VOLUME XXXIII.—SECOND SERIES.

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THIRTY-THIRD VOLUME.—SECOND SERIES.

WOOD ENGRAVINGS.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CXCIII. SECOND SERIES. June 1818.

Specification of the Patent granted to John *and* George Dickinson, *of Nash Mills, in the County of Hertford, Paper-Makers; for certain Improvements in the said* John Dickinson's *Patent Machinery for manufacturing Paper, and also certain Apparatus for separating the Knots or Lumps from Paper or Paper Stuff.*

Dated August 24, 1814.

With an Engraving.

TO all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, we the said John and George Dickinson do hereby declare that the nature of our said invention and the manner in which the same is to be performed, are particularly described and ascertained by the drawing hereunto annexed, and the following description thereof; that is to say: In the first place, with regard to the improvements of John Dickinson's patent machinery for the manufacture of paper; the first improvement consists in a method of regulating the passage of the water through the cylinder, when at work in making paper, as described in the said John Dickinson's Specification, enrolled in the High Court of Chancery on the twenty-first day of November, one thousand eight hundred and

 eleven,

eleven, in the annexed drawing*; the tube marked A in the horizontal section of the machine, Fig. 1 (Plate I.) is answerable to the tube referred to in the above mentioned former specification, and marked G in the drawing thereto belonging; on each end of it, but within where the ends of the cylinder work, are fixed two rings B B, which are turned so as to be about three-eighths of an inch less in diameter than the inside of the making cylinder; after these rings are fixed on the tube, there is fixed to them a casing of wood or metal extending from one to the other in a direction parallel with the axis, but not projecting beyond the periphery of the rings B B, so as to form a segment of a cylinder of three quarters round or thereabouts, or as marked in the drawing, Fig. 1, from about C to D; the effect of this part is, that when the machine is at work and the back filled with pulp, the water which runs through the making cylinder must pass through the narrow openings of three sixteenths of an inch wide or thereabouts, which are found at each end between the rings and the inside of the cylinder, which spaces are calculated to allow a sufficiency of water to pass for making of paper, but so regulate its passing that it cannot run through too fast, when the uncovered part of the cylinder first enters the pulp.

The next improvement consists in removing the air

* In Fig. 2 the making cylinder is not drawn when at work, but stands fixed during the rotation of the cylinder, for which the tube A forms an axis. The trough for receiving the washing water is not shewn in this figure, nor the pipe that conveys it away, but it is led out through the same end of the tube as the air and suction pipes. The whole of the above is cased with wood below the line marked D, which is intended to correspond with the points C D, in Fig. 1, so that the water entering the cylinder has no direct passage towards the centre, but must pass through the narrow space between periphery of the rings and the inside of the cylinder. The spans between the arms of the rings B B are of course open.

trough,

trough, described in the said former Specification, out of which the air was pumped, so as to cause a partial vacuum under that part of the cylinder which was passing over the trough, and in lieu of it to suck the air from the inside of the cylinder itself, by a pair of air pumps constantly going while the machine is at work, to which a pipe is led from the inside of the cylinder through the tube A, and the pipe is marked E in the annexed drawing. It is to be observed, that the orifice of this pipe should be above the level of the water inside the cylinder.

The third improvement consists in the application of condensed air to force the paper off the cylinder, at the point where the couching takes place; the method of doing this is to fix a small trough F inside the cylinder between the rings, exactly parallel with the axis of cylinder, and as near as possible below the centre of the couching roll; this trough has a flanch all round it, shaped so as to correspond with the inside of the cylinder, and the flanch has leather sewed upon it, and when the trough is fixed in its place, the leather is pressed up against the cylinder, and the cylinder in going round rubs upon it; but it is necessary to take care that the leather covers the flanch only and not the opening of the trough. The air pumps for the suction must be made to act so as to force the air that they discharge into a receiver, where it accumulates and becomes condensed equal to a pressure of about one pound on the square inch, and the pressure requires to be regulated by a safety valve, through which the surplus air may escape. From this condenser a pipe is led into the cylinder through the tube A, where it is branched and conveys the air into the couching trough F, at each end to which the pipe is connected by joining screws, the pipe is marked G, the joining screws H H; as the water during the working of the machine accumulates in this trough,

there is a pipe I, led away from the centre of it, which opens inside the cylinder, but as near the bottom as possible, through which that water escapes. It is necessary to be careful that the trough is so fixed that the condensed air has no passage out of it into the inside of the cylinder, as that would prevent the operation of the suction.

The fourth improvement relates to the washing of the cylinder while at work in making paper; for this purpose a pipe K is fixed over the cylinder, nearly in the situation shewn in Fig. 1, and parallel with the axis; this pipe has a slit in the under side of it, from which a jet of water is forced out upon the surface of the cylinder; of course clear spring water is best for this purpose; but it should not be allowed to mix with the water that runs through from the pulp, and on that account there is a trough L fixed in the inside of the cylinder between the rings B B, with a flanch round it, and the flanch covered with leather in the same manner as the other trough; and when in its place it is intended also to be close up against the inside of the cylinder *c*, must be as near as possible to the other trough; from this trough there is a pipe M also led away through the end of the tube A, and the water which has passed through the cylinder runs to waste; between the lower side of the trough L and the point C, there is fixed a piece of wood, the upper side shaped so as to fit the inside of the cylinder and (when the machine is at work) rubbing against it; the purpose of this is to prevent the suction drawing air in through this part of the surface of the cylinder. In order to allow of these alterations, it is necessary to have the tube A different from what it is described in the former Specification, before referred to, where it is marked G, and the use of the pipes marked therein L, L, L, L, may be given up, and also to have the upper side of the tube open

open to allow of the pipes E, G, M, and the water entering. It is also to be observed, that the water which passes for making the paper, according to this plan, goes out at one end only where the cock is fixed, and consequently the tube must be larger in proportion; the three pipes E, G, M, all pass through the other end, and the tube must be stopped up round them by stuffing in tow or some other contrivance, in order that water may not get out nor air get into the cylinder through it. The making cylinder is only shewn in Fig. 1, and is distinguished by three arrows which shew the direction of the motion.

The second part of the said invention or discovery, *viz.* the apparatus for picking paper, we describe as follows, *viz.* In the annexed drawing, Fig. 3 represents a section of the machine, N N is the frame, O a round reel on which the paper marked P is reeled as it comes from the machine, and afterwards brought to this frame to be drawn off. The paper is first led over the small octagonal roll Q, which is covered with felt, and has a motion in the same direction with the paper of about three hundred revolutions per minute; it is next led over the straight edge R, which is fixed to the side of a piece of wood S, and being drawn rather tight over it forces the knots to project from the upper side of the paper; it is afterwards led over the cushions S S, which are merely pieces of wood rounded on the upper side and covered with felt or woollen cloth; the paper is then reeled on the reel T, which has a motion given to it, so that it may draw the paper at the rate of about forty feet per minute. The motion should be given by means of a clutch, or some method that will admit of the reel being struck out and detached when full, and the empty reel being substituted in its place; but there are so many well known methods of performing this, that it is unnecessary

cessary to give a description; V V are two wood brackets fixed one on each side of the frame for carrying the cushions and the octagonal roll. The rollers W W have each about twenty-four bars of very thin sheet-iron in them, as shewn in the drawing marked X X, and these rolls are moved round in the same direction that the paper travels, at about the rate of two hundred and fifty revolutions per minute, with the extremity of the bars or teeth lightly brushing the paper; but it is intended that the second roll should touch the paper rather harder than the first. In the construction of these rolls it is requisite that the edges of the bars should be perfectly straight, and project an equal distance from the centre, and the top of the cushions should be exactly parallel with the centre of the rolls, so that the paper may be level, and that the bars may touch along the whole breadth of it. It is requisite to have the means of raising or lowering the rolls W W, according as it may be found expedient to brush the paper with the teeth harder or more lightly; for that purpose the bearings are on bracket carriages, which are fixed to the frame by bolts and have chased mortices; the same effect may be produced by having the cushions to shift up and down; there are two small guide rolls Y Y, which should be fixed in some way that they can be raised or lowered, so as to adjust the friction of the paper. The octagon reel for reeling the paper upon is preferred on account of the angles being obtuse, so that it draws the paper nearly in an uniform direction over the cushions. It is well known that in the process of making paper by the machine, the grit finds its way to the side of the sheet next the wire on which the paper is made, and the knots usually are found on the upper side; the intent of this process is to remove the grit by the friction of the small octagonal roll, and to scratch the knots off by means of the bars in the rolls W W; of

course

course the method of leading the paper and the arrangement of the apparatus admit of variation, but that above described is thought to be most convenient and eligible.

In witness whereof, &c.

Specification of the Patent granted to JOHN MAELZEL, *of Poland Street, in the County of Middlesex; for his Instrument or Instruments, Machine or Machines, for the Improvement of all Musical Performance, which he denominates a Metronome or Musical Time-keeper.*

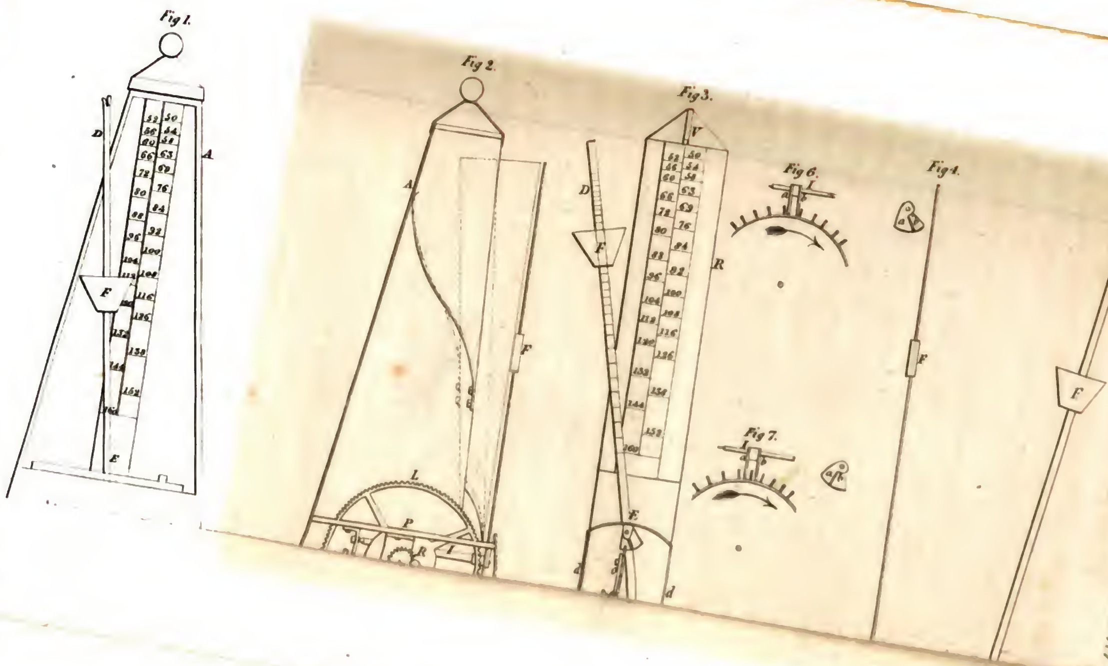
Dated December 5, 1815.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Maelzel do hereby declare, that my said invention is described and ascertained in manner following; that is to say: my instrument or instruments, machine or machines, for the improvement of all musical performance, which I denominate a metronome or musical time-keeper, is for the purpose of counting or beating the time for music, or in other words for dividing, indicating, or marking equal portions or intervals of time, whereby to regulate and determine the degree of quickness or slowness, with which any piece of music shall be performed. These equal intervals of time are measured by the vibrations of a particular kind of pendulum, whereof each vibration is indicated in an audible manner to the performer, by the tick or drop of an escapement, similar to that used in a certain description of clocks; and the said escapement, by transmitting the action of the maintaining power of a weight or spring to the pendulum, keeps it in continual oscillation, as long as the weight or spring continues wound up. The construction of the pendulum which I employ in my machine

chine is such as to admit of readily adjusting the period of its vibrations, that any necessary number shall be performed in a minute of time, thereby to adapt it to beat or keep the time for the performance of all the different kinds of music, whether the movement of the same be quick or slow. By this means the performance of music will be improved, because the intervals of time will be always referred to the same standard, viz. the number of vibrations in a minute; and the equality of the said intervals will be more perfectly attained by this means, than by the ordinary mode of counting or beating equal intervals of time by the hand or foot. But be it known that I do not make any claim to the invention of beating or counting the time for musical performance, by means of a machine regulated by a pendulum; but for the particular manner and mode which I have invented of applying a pendulum to such a machine, whereby the pendulum can with the greatest facility be made to vibrate a greater or less number of times in a minute at the pleasure of the performer; and this admits of each vibration being marked by the tick or drop of the escapement, without any hammer or other apparatus for that purpose. To effect this regulation of the vibrations, I make the pendulum so short from its centre of motion to the weight or bob, that it will vibrate quicker, or perform its vibrations in less time than ever can be required for beating time in music, and I continue the rod or stem of the pendulum above the centre of motion; and upon the upper part of the rod or stem I apply a second weight or bob in such manner, that it can at pleasure be placed at a greater or less distance from the centre of motion; the action of this second weight placed above the centre, is to retard the motion of the pendulum, and the higher it is placed above the centre, the slower the vibrations will be, and *vice versâ*. The rod or stem is divided into certain

Mr. Maelzel's Patent.



tain notches, and the secondary weight has a spring catch to hold it at any required notch, and support the secondary weight at any part of the rod. A scale is placed behind the pendulum with a division opposite each of the notches, and the divisions are figured with the number of vibrations which the pendulum will make in a minute, when the weight is placed upon the rod opposite to any of the divisions of the scale. By this application of a sliding weight to the upper part of the stem or rod of the pendulum, I can render the machine very portable and convenient; for a pendulum that will vibrate 40 or 50 times per minute, will be found to suit the performance of the slowest music; and a pendulum for this purpose, constructed according to my invention, can be contained within a machine of only one foot in height to the centre of motion; the same pendulum will vibrate 160 times per minute; whereas a common pendulum, with a single weight or bob beneath the centre of suspension, would require to be of a very inconvenient length to vibrate at so low a speed as forty per minute.

The metronome or musical time-keeper may be constructed in different forms or dimensions, and may be kept in motion either by a spring like a watch, or by a weight in the manner of a clock; and wheel-work in either case be introduced to keep up the action of the machine for a longer or shorter period of time, and also different kinds of escapement may be employed, provided they will produce a sufficiently audible tick or beat. But to render this my specification more precise, I have hereunto annexed drawings of two different constructions of the instrument, one put in motion by a spring, and the other by a weight.

Fig. 1 (Plate I.) is an elevation, and Fig. 2 is a section of a metronome, which is contained in a pyra-

mid or case A B C, or any other figure may be employed according to the fancy of the maker, as D E is that part of the stem or rod of the pendulum which is above the centre of motion E, and F is the sliding weight fitted upon it; H is the bob or weight at the lower end of the pendulum. The same letters of reference are used in Figs. 4 and 5, which represent the mechanism detached from the cases to render the construction of the instrument more clear; I is the axis upon which the pendulum swings, and at the opposite end of it are fixed the two pallets *a b* of the escapement; these pallets are actuated by the teeth of the swing or escapement wheel K, which has a pinion upon its axis turned by the toothed wheel L, to which the spring box M is fixed; the arbor *m*, in Fig. 5, of the wheel L and spring box, is made square at the end *m*, Fig. 5, and this is turned round by a key when the spring of the metronome is to be wound up. The ratchet wheel *n* is fixed upon the arbor *m*, and the spring catch *o* acts in its teeth to prevent the return of the arbor after winding up the spring, as the arbor must not revolve when the machine is in action, although the wheel and the spring box turn round upon the arbor by the action of the spring; the spring is coiled up into the box M the same as a watch spring, and the outer end of the coil is fastened to the inside of the box, whilst the inner end of the coil is attached by a hook to the arbor *m*; therefore, when the arbor is turned round by applying the key to the square *m*, it winds up the spring, and as the click of the ratchet-wheel *n* prevents the arbor turning backwards, the natural tendency or action of the spring to unwind itself turns the spring box and the wheel L round, in the direction of the arrow; the teeth of the wheel L acting in the leaves of the pinion, turn the escapement wheel K in the direction of its arrow, and the

the teeth of the escapement wheel K are determined by the pallets *a b,* so as to prevent the wheel turning round, except one tooth at every time the pendulum vibrates. The pallets are two small sectors of polished steel fixed on the axis I, at a small distance behind each other, and the adjacent edges are exactly in a line, as shewn in Figs. 6 and 7. When the top of the pendulum inclines to the left side of the perpendicular, the front pallet *a* detains the tooth of the escapement wheel, slips by the edge of the front pallet *a,* and falls upon the second pallet *b,* as in Fig. 7; but as the edge of the pallet is inclined or sloped at an angle to the motion of the wheel, the tooth when it slips by gives an impulse to the pallet, and makes the pendulum swing forwards on the right side of the perpendicular, which it does until by its gravitation it is brought back; and when it returns to the perpendicular, the tooth which in Fig. 7 was between the two pallets *a b,* and rested against the back pallet *b,* likewise drops off the sloping edge of that pallet, and a succeeding tooth of the wheel drops upon the front pallet *a,* in manner of Fig. 6; in the dropping off the sloping edge of the pallet *b,* the tooth of the wheel impels the pendulum to the left, and in this manner the action of the machine continues till the spring is recoiled, and thus requires to be again wound up. At every time a tooth of the wheel drops against either of the pallets, it makes a blow which can be plainly heard; but to render it more audible and distinct, the end pivot of the axis of the pendulum projects through beyond the cock which supports it, and is made to bear against a piece of metal plate, or thin wood, or other similar substance, which then receives the blow and makes a sufficient sound, when the machine is inclosed in the pyramid A B C, Figs. 1 and 2, which may be made of tin or other metal, and of

the axis of the pendulum the end pivot bears against the sides of the same, as shewn in Fig. 2.

The divided scale which is shewn behind the pendulum in Fig. 1, is for shewing where to place the sliding weight F upon the rod D E, for vibrating any required number of times per minute, the maker of the instrument must lay down and adjust the divisions of the scale by experiment. The frame which supports the mechanism consists of a brass plate P, to which cocks *p* are screwed to support the pivots of the wheels R; Fig. 2, is a small wheel to prevent overwinding, the spring turns round upon a pin screwed to the centre part of the great wheel L, and a projecting tooth or pin which is fixed to the arbor *m* of the wheel L acts in notches, which are cut in the edge of the wheel R, and thereby turns the wheel round upon its centre pin one notch every time the arbor *m* makes a revolution; but there are only as many notches cut in the edge of the wheel R, as the number of times the arbor *m* is intended to turn round in order to wind up the spring, and this number of turns being compleated, the projecting leaf of the arbor *m* stops against the solid edge of the wheel R, and prevents the arbor being turned any further, because there is no notch made in the edge of the wheel to reeeive the projecting leaf.

The metronome may be moved by a spring barrel the same as are used in ordinary watches, instead of the spring box as is represented in the drawing, and also the number of wheels may be increased to make the motion continue longer without winding up, if the same is thought desirable.

The metronome shewn in Fig. 3 is more simple in its structure, as it is adapted to be put in action by a weight instead of a spring, and in this case it does not require

any

any other wheel-work than the escapement wheel K, when the weight can be made to descend from a considerable height. This instrument is intended to be suspended in a perpendicular direction in any convenient place, and the brass cock or frame *dd*, which supports the pivots of the escapement wheel K, is secured to the wooden ruler or scale R, which has a hook or loop at the upper end, by which the instrument is suspended; the line or cord to which the weight M is connected, passes over a pulley fitted upon the axis *m* of the escapement wheel, with a rachet wheel and click, so that it will admit of winding up the weight by pulling down the small counter weight T, which is attached to the opposite end of the line. The escapement and the pendulum with its divided scale are the same in this machine as in the former; at the upper end of the scale is a small piece of brass V, which turns down upon a hinge or joint, so as to intercept the upper end of the pendulum to stop the motion when required.

In witness whereof, &c.

Specification of the Patent granted to THOMAS WHITTLE, *of the City of Chester, Wharfinger, and* GEORGE EYTON, *of the same City, Gentleman; for an improved Kiln, for the Purpose of drying Malt, Wheat, Oats, Barley, Peas, Beans, and other Substances, by Means of Steam, assisted by Air.* Dated June 10, 1817.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, we the said Thomas Whittle and George Eyton do hereby

hereby describe and ascertain the nature of our said invention, and in what manner the same is to be performed, by the plan or drawing in the margin of these presents, and the following description thereof; that is to say: The pipes, &c. are calculated for a floor of eighteen feet square; and it is seen, by the plan, that the steam from the boiling water first communicates its heat to the floor of the kiln; and that the pipes G, (Plate II.) fixed to each angle of the floor, and also the pipes E, with which they communicate, and which are connected together in the square box F, at the centre, (being the only passages through which the steam can escape,) are likewise heated by the steam passing through them. These pipes are considered of service, to assist the process of drying, as it is found that any dampness thrown up from the article in drying by the heat of the floor becomes attracted by the heat above, and passes off much quicker than it otherwise would. The mode of conveying air under the floor is seen by the plans, Nos. 1 and 2, to be by pipes from the boundary wall, that is to say one, I, to the centre of the floor of ten inches diameter, and four others, H, to each of the mid angles of eight inches diameter. These pipes, by passing through the boiler, are attached to the under side of the top part of it by elbow and flange, and are steam-tight. The other end of the pipes through the boundary wall can either be closed or not, as is found necessary in the process of drying, but till the moisture is sufficiently evaporated it is found best to keep all the air pipes open. The air in passing through the pipes is of course considerably heated before it passes through the tiles on the floor. Independently of these pipes to convey air, there are openings, four inches and a half deep, in the boundary wall, corresponding with the spaces between the blocks which support the tiles, for

for the purpose of admitting air through the kiln, and for cleaning out the dust that may occasionally fall through the tiles, which may be done with a small rake and brush. For quick drying, it is recommended that the whole of the said openings in the boundary wall should be stopped close: in which case the whole of the air conveyed under the floor will pass through the said pipes I and H; from the formation of the tiles W, and the circular blocks Y supporting the same, it will be seen that the air once admitted will easily spread through every part of the space under the floor, and penetrate into the drying room through the perforations in the tiles and whatever lies on the floor to dry. The boiler may be of cast iron or forge iron; but forge iron plates, a quarter of an inch thick, rivetted steam tight, will be found less subject to accident, and may be put together at about the same expense as cast iron. To prevent accident in feeding the boiler with cold water, a block of deal wood is attached to the end of a pipe J, from the cistern, which floats on the surface of the water inside the boiler, and regulates the supply in proportion to the evaporation.

Reference to the Drawing.

Fig. 1, section through the fire place, boiler, and drying room.—A, the valve for the escape of waste steam. B, the line to regulate the valve. C, the escape pipe, six inches diameter. D, the cupola. E, pipes for conveying the steam from the boiler, six inches diameter. F, square box, to connect the pipes E, communicating with the pipes G from each angle. G, upright pipes, six-inch diameter, to connect the boiler with the pipes E. H, pipes, eight-inch diameter, to convey air through the steam,

steam, and attached to the plate by a flange, which charges the space under the tiles with warm air. I, a pipe, ten inch diameter, for the same purpose as pipes H. J, a pipe to convey water from the cistern to the boiler. K, half-inch pipe, fixed three inches above water-line, to ascertain whether there is too great a change of water in the boiler. L, half-inch pipe, fixed three inches below water-line, to ascertain a proper quantity of water in the boiler. M, cistern to supply boiler with water. N, flue round the boiler, to convey smoke to chimney. O, the fire-grate. P, the ash-pit. Q, plate between fire grate and door used for the purpose of burning smoke. U, the section of the tile and circular block. V, the section of the plate. W W, plan and section of one of the tiles, twelve inches square and two inches thick, full of small holes through. X, the section of the block. Y, the block, four inches and a half high, and the diameter of which is six inches.

Fig. 2, plan of half the top of the boiler, and half of the drying-floor.—R, shewing half of the floor with the tiles on. H, eight inch pipes, to convey air under the floor. G, six inch pipes, to convey steam from the boiler to heat the drying-room. S, half the floor with the tiles off, shewing the covering of the boiler. I, the ten-inch pipe, conveying air to the centre of the floor.

Fig. 3, plan of the fire-place and flue of the chimney.—T, the ground plan. O, the grate. Q, the plate between fire-grate and door. N, the flues.

In witness whereof, &c.

Whittle & Eaton's Patent.

Pl. II. Vol. XXXIII. S.S.

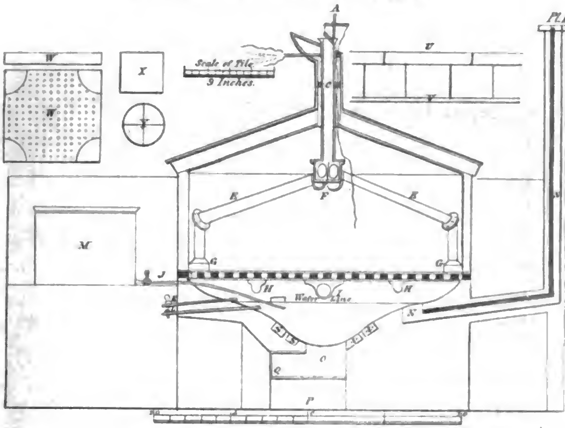


Fig. 1.

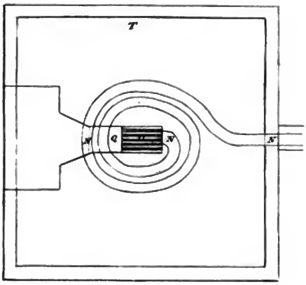


Fig. 3.

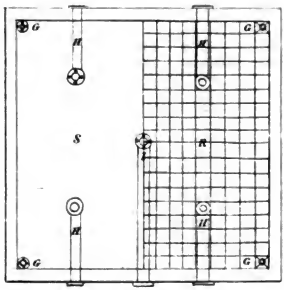
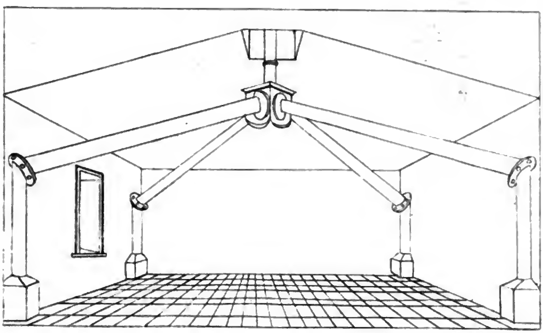


Fig. 2.



View of the Drying Room.

Specification of the Patent granted to ROBERT JAMES, *of Bruton-street, in the County of Middlesex, Doctor in Physick; for a certain medicine called "Dr. James's Analeptick Pills," being a sovereign Remedy for Rheumatisms, whether seated externally or internally, for Indigestions, Crudities of the Stomach, from Intemperance, loss of Appetite, habitual Costiveness, Giddiness in the Head, troublesome Flatulencies in the Stomach and Bowels, and Cholicks, thence arising; as also gouty Habits, where the Stomach and Head are affected; and for all Kinds of bilious Disorders, Lowness of Spirits, and Nervous Complaints, as well as in those Disorders occasioned by a sedentary Life.*

Dated November 25, 1774.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Robert James, in compliance with the said proviso, do hereby describe and ascertain the nature of the said invention, and declare that the same is composed of the several particulars following; that is to say: The analeptic pills are made by mixing equal parts of the pill rufi, gum ammoniacum, and the fever powder. The two former are first to be placed in a large cave under ground, furnished with the conductors of electrical fire, which will dissolve the ingredients. When they are so dissolved they are to be mixed with the powder, and made into pills, with a solution of gum arabick.

In witness whereof, &c.

Further Observations on Mr. HENRY TRITTON'S *Patent for an improved Apparatus for Distilling.*

Communicated by the Patentee.

WHEN the writers of the *Memoire on the Distillation of Sea-water* * pronounced, as they have done, an opinion unfavourable to distillation in vacuo, they had not been made acquainted with the invention which is the subject of my Patent, (see the last volume of this work,) nor had they seen the advantages resulting from its use. It would not be difficult to confute the arguments they make use of, on acknowledged principles, nor to shew that their opinion is opposed to some of the first authorities in this matter; but it is become unnecessary to attempt to invalidate their opinion, either on principle or by reference to scientific authorities: practical experience may now be opposed to theory, since repeated experiments abundantly confirm the opinion expressed in the letters of Mr. Benwell and Mr. William Allen, that with my improved apparatus for distilling, the operation may be performed with equal facility, and that a material saving of fuel will result from its use.

Those gentlemen who wish to see the improved apparatus for distilling in action, are requested to apply to Mr. Henry Tritton, at the copper and pewter manufactory, No. 63, Whitechapel, London, where the improved apparatus for distilling is made, and where it is erected.

Mr. Tritton's improved apparatus for distilling is, he conceives, peculiarly adapted for the distillation of sea water; as the moderate heat at which the distillation is effected will prevent the bringing over the saline particles, and remove that fiery taste which is so justly the subject of complaint.

* Published in vol. XXXII. of this work.

On

On Locomotive Engines.

Mr. BLENKINSOP'S *Answers to Sir* JOHN SINCLAIR'S *Queries respecting the Conveyance of Coals on Rail-ways by Steam Engines.*

QUERY 1. By whom were they first tried or invented?

Answer. By Mr. Blenkinsop, who had a patent granted in April 1811.

Query 2. How long have they been in use, and at what works?

Answer. At Middleton colliery near Leeds, belonging to Charles John Brandling, Esq. since June 1812; also at Wellington colliery, John Waston, Esq.; at Orrell colliery near Wigan, Lancashire; Kenton and Coxlodge collieries, near Newcastle, Northumberland.

Query 3. What is the original expense?

Answer. The steam carriage, with two eight inch cylinders, will cost £.400.

Query 4. What is the weekly or monthly expense of fuel, and quantity of coal consumed?

Answer. Eight hundred weight of coal will supply the machine twelve hours, and will cost sixteen shillings per week, fifty gallons of water an hour.

Query 5. What weight do they draw?

Answer. The engines at present in use convey one hundred tons.

Query 6. What is the difference of expense between them and horses?

Answer. The additional expense in laying the rail-road is £.200 per mile to that calculated for horses. The locomotive engine of eight inch cylinders is performing

the work of sixteen horses in twelve hours, and as the annual expense does not exceed £.200 the savings will therefore be, by the use of this invention, at least £.1200 per year for each machine employed.

Query 7. At what rate might they be made to go per hour?

Answer. When the carriage is lightly loaded, it travels at the rate of ten miles an hour; but when loaded, with twenty-seven coal waggons, each weighing three and a half tons, it is propelled on a dead level at the rate of three and a half miles an hour. The machine weighs five tons.

Query 8. Could they be made applicable to public roads, for instance, from London to Edinburgh, if iron rail-ways were made along the sides of the road?

Answer. Yes. The only inconvenience would be in going through large towns, to remedy which, wheels might be made to run on pavement as well as the rail-road, and the machine taken through the town by horses, or engines might be in the immediate vicinity of large towns, and the goods only conveyed through.

Query 9. What weight would they draw up a hill on a rail way?

Answer. Fifteen tons up a hill rising two inches in one yard.

Query 10. Are there any objections to the general use or extension of these machines?

Answer. It would only be necessary to obtain a licence of the Patentee.

The steam carriage was at work last winter at Middleton, night and day, and was not impeded during the great falls of snow.

Mr.

Mr. Blenkinsop's *Answers to Sir* John Sinclair's *Queries respecting the Conveyance of Coals on Railways by Steam* *.

1st. They were tried about 1802 in Cornwall by Messrs. Trevethick and Vivian, who gave motion to the wheels of the carriage, in the manner described in their Specification, printed in March 1804, in the 22d number of the 2d Series of the Repertory of Arts.

Some few years since a further attempt was made near Newcastle by a Mr. Whinfield, with an engine on Trevethick's principle, *viz.* with a high pressure of steam, and no condensation. This was laid aside, apparently from the engine being too heavy for the strength of the rails; also, because the friction of the wheels of a locomotive engine cannot overcome their tendency to slip on an iron rail with any material ascent, when drawing a train of waggons after it.

In consequence of the latter difficulty, Mr. Blenkinsop, of Leeds, invented and obtained a patent (see Repertory, vol. XXI. page 138, Second Series,) for using a continuous rack, or toothed indenture on one side of the line of iron rail, which being acted upon by a toothed wheel fixed to the locomotive engine and moved by it, was capable of exerting its whole strength without danger of slipping. This method has been carried advantageously into effect both at Middleton colliery near Leeds, and on Cox-lodge railway near Newcastle; and would have become very general but for the great charge attendant on altering one side of the iron rail-way to fit it

* Note, in the article Canal in Dr. Rees's New Cyclopædia, vol. VI. it is stated, that in February 1804, a trial of Mr. Trevathick's engine was made by Samuel Homfray, Esq. on the Cardiff and Merthyr rail-way, where ten tons of iron were drawn by one engine, at the rate of near five miles per hour.

with

with a continuous rack, and the other side to give it sufficient strength to sustain the weight of the locomotive engine; which together with its water, coals, &c. weighs not less than six tons. This plan is in use at Killingsworth colliery near Newcastle.

With a view to remedy both these inconveniencies, Messrs. William and Edward Chapman, of Newcastle, took out a patent for England and Scotland in December 1812. The specification of the patent is published in the Repertory, vol. XXIV. p. 129, and it consists wholly in the two following points, *viz.*

1. In reducing the relative weight of the locomotive engine upon rail-ways, by so placing it either on six or eight wheels, that it may rest equally and move freely round the curves of the rail-roads, to which only that part of their invention extends.

2d. In using a continuous chain stretched along the way and secured at the ends, which, by being passed over a grooved wheel (with iron Y's) attached to the frame of the engine, and moved by it, enables the locomotive machine to haul itself and its load up hill, as has been effectually proved under very disadvantageous circumstances on the wooden rail-way from Heaton colliery to the River Tyne. Whilst the machine for this road was constructing, further trials have been made on iron rail roads nearly level, by causing the locomotive engine to give motion to its travelling wheels according to Trevethick's principle, which in those cases have been found to answer uncommonly well, excepting as to the necessity either of strengthening the waggon-way rails, or of adopting Messrs. Chapman's mode of placing the engine on six or eight wheels. In consequence of the efficacy of friction, or resistance to the slipping of the carriage-wheels of the locomotive engines, it will only be found

found necessary to place chains on the parts of rail-ways materially ascending; which at those parts can very quickly be laid over the grooved wheel. And the waggons when arrived at the upper end will disengage themselves, so as to proceed by friction alone.

Beside these methods there is another invented by Mr. Brunton, of Butterley, in Derbyshire, (see Repertory, vol. XXIV. page 65, Second Series,) who causes the locomotive engine to push itself forward (and the waggons attached to it) by means of certain struts, or poles with broad feet acting obliquely against the ground, being drawn back and pushed forward alternately; this method is now on the point of being tried on a rail-way near Sunderland.

Query 2d.—Answered in the above.

Query 3d.—From £.350 to £.450 according to the size, &c. of the engine.

Query 4th.—Not ascertained; must vary according to circumstances.

Query 5th.—See answer to the 9th query.

Query 6th.—Not yet correctly ascertained, but supposed to be about one-fourth to one-fifth the expense of horses.

Query 7th.—See answer to query 9.

Answer to the 8th query:

They cannot be advantageously applicable, parallel to the great high roads from London to Edinburgh, for instance, because of the vast inequality of the ground over which the high roads pass to bring them into use; railways should be laid out with due attention to level, and the hills should be got over by steep ascents, by means of stationary engines to draw the carriages up hill: on this subject sufficient general information may be obtained, by perusing the latter part of Mr. William Chapman's

man's Report on various projected Lines of Navigation from Sheffield, printed by James Montgomery, of that place, in 1813, and accompanied by a map of all the circumjacent country.

Answer to the 9th query:

A well-constructed locomotive engine with two eight-inch cylinders on Trevethick's principle, should draw 40 or 50 tons (waggons included) at the rate of four miles an hour on a level iron rail-way; and up an ascent of one and a half inches to the yard, will hardly move at the rate of one and a half mile an hour with 40 tons, or not so fast.

10th Query:

The answer to the 8th query is applicable to this.

Newcastle, 5th Oct. 1814. J. B.

Description of a cheap Level for Agricultural and other Purposes.

Communicated by the Inventor, T. N. PARKER, *Esq. of Sweeney.*

With a Wood Engraving.

TWO cylindrical receivers of about five-eighths inch interior diameter, and full three inches high each, for holding quicksilver, are fixed at right angles upon a wood-stand, and about eighteen inches asunder.

A small groove is cut lengthways in the stand, and closely covered over, through which channel a communication is effected between the two cylinders; and consequently, the surfaces of the quicksilver in the cylinders must be on a level with each other.

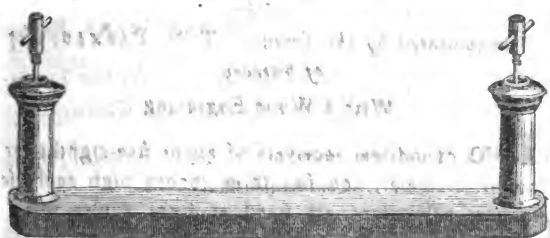
The two floats are equal to each other as to weight, length, and the surfaces of about five-eighths inch diameter, which rest on the quicksilver in each cylinder; and

and consequently, the tops of the floats must also be on a level with each other.

The different parts of the level are closely fitted, and the whole rendered *portable*, by screwing up the floats into the caps of their respective cylinders. About three minute grooves are cut in the lower or hemispherical ends of the floats, through which the quicksilver rises upon a slight pressure of the floats, and falls back again under the floats as soon as the pressure is taken off.

The tops of the cylinders are a little concave, for saving any particles of quicksilver which may lodge in the screws when the instrument has been shaken about in carriage.

For proving this instrument, take any object at some distance, on a level with the tops of the floats; then turn the instrument half-round, and if the same object still corresponds with the tops of the floats, the instrument must be accurate.



Mr. Thomas Appleton, Turner, 173, Drury-lane, London, has taken great pains in contriving tools, and making this instrument in a very complete manner, under my immediate inspection; and it has been shewn to many distinguished agriculturists who highly approve of the contrivance. Mr. Appleton has allowed me to fix such terms between him and the public, as appear reasonable; and although I put no restriction upon any

other person's imitating this instrument for his own advantage, yet from having seen so many difficulties contended with and overcome in completing it (simple as it is in principle), I beg that the merit of the contrivance may be judged of by those instruments alone which are made by Mr. Appleton. In proving the instrument, let it be shaken and jarred in all directions, and if any quicksilver escapes it should be returned as imperfect.

London, May 20, 1818. THOMAS N. PARKER.

Printed directions are pasted on the instruments, price of the level 14*s.* graduated staff 8*s.* stand with three legs 4*s.*

On the Embanking 300 *Acres of Land on the Gnoll and Britton Ferry Marshes.*

By the Earl of JERSEY *and* HENRY GRANT, *Esq.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Silver Isis Medals were voted to the above Gentlemen for this Communication.

OBSERVING the encouragement held out by the Society of Arts, for the Recovery of Land from the Sea, we have caused the inclosed statement to be laid before the Society, of the mode of embankment, by which we have recovered about 300 acres of excellent marsh land. Before this undertaking, the whole of it was open to the influx of the sea, and covered with water several feet deep every spring tide, exclusively of being liable to inundation from land floods.

The

The deposits of sand and mud thus continually left on the land, and the numerous deep holes with which it abounded from the action of currents, rendered the herbage of little value; since this improvement, the whole of the land thus recovered is expected to produce, on an average, from 40*s.* to 50*s.* *per* acre, even under all the present pressure upon the agricultural interests.

The present low price of labour will, we presume, be fully adequate to meet any temporary depression in the value of land recoverable in similar cases, and we trust this statement, if it should be deemed deserving of a place in the volume of the Transactions of the Society, may be the means of encouraging others to follow an example, combining public benefit with private interests. There seems good reason to believe, that this and other undertakings of the like nature might materially improve the port of Neath, now become a place of great traffic in coal and culm, by confining the river to its natural bed; and the employment, in works of this nature, of some of the surplus labour with which most parishes at present abound, would, at the present crisis, operate towards the relief of all classes.

Copy of an estimate of an intended embankment of a salt marsh adjoining Neath river, in Glamorganshire, referred to in the accompanying statement submitted to the Society for the Encouragement of Arts, &c. which estimate was delivered to the Earl of Jersey and Henry Grant, Esq. proprietors of the said marsh, 11th August 1815, by

Evan Hopkin,
David Hopkin,
Roger Hopkin, } Engineers.

To

	£.	s.	d.
To 3288 yards of embankment, ...	1479	12	0
To four culverts, with all necessary mason water-work, and inside gates to admit and confine the tide within the embankment if required,........................	160	0	0
	£.1639	12	0

The following particulars respecting an embankment of about 300 acres, situate on the river Neath, in Glamorganshire, are submitted to the Society for the Encouragement of Arts, &c. by Mr. Lewis Thomas, jun. of Britton Ferry, Steward to the Earl of Jersey, at the instance of his Lordship, and of Henry Grant, Esq. of Gnoll Castle, in Glamorganshire.

The Earl of Jersey having recently become entitled to the Britton Ferry estate, arrangements were speedily made between his Lordship and Mr. Grant, the owner of an adjoining estate, for recovering a tract of about 300 acres of marsh lands, upwards of 100 of which belonged to his Lordship, about 150 to Mr. Grant, and the remainder to Herbert Evans, Esq. of Eagles Bush. For time immemorial this tract had been covered during every spring tide with several feet of water, and was also partially covered by low tides and land floods; it lies upon the banks of the river Neath, near its confluence with the sea, between Britton Ferry and Neath; is flanked by the Neath canal towards the South, and by the river towards the North, the frontage extending on the river side 3288 yards.

The undertaking was principally entrusted to Mr. Evan Hopkin, a farmer on the Earl of Jersey's estate, now upwards of seventy years of age: he has for many years acted as an engineer with great advantage to his employers; and various works of that nature will long remain

main to attest that natural talent may be very useful, though unaided by education; in the execution of this work he had the assistance of two sons, who are also very able men as engineers.

The estimate made on this occasion is subjoined, because, unlike most estimates in similar cases, it constitutes the whole charge of the undertaking, and a sketch of a plan is added, to convey a more correct idea of the embankment.

The sea bank was carried the whole length of the inclosure next the bed of the river, as near to it as the nature of the soil would admit; its length is 3288 yards; its breadth twenty-nine feet at the base, from four to six feet at the top, which is flat, and its perpendicular height averaging six feet, except a part nearest the sea, where the swell is often very considerable, and which is forty-two feet at the base, six feet at the top, and nine feet high; the soil being at this part of a very sandy texture, and not so well adapted for an embankment. Advantage was taken of several pills formed by currents across the land for the purpose of draining off the rain and land water, and any leakage from the canal into the river at low water, by means of culvert and tide-gates.

The land is uniformly to the depth already ascertained, being about three feet, a strong deep alluvial soil, capable of close consolidation; great attention was paid in the formation of this bank; its base was formed of sods neatly cut and exactly fitted, and let into the ground six or eight inches below the surface, with the grassy side outwards, and particular care taken that no vacancies should be left between the sods to admit water, and the whole well beaten and rammed together: in this manner the bank was continued nearly its whole length, and to about half its height, and the spring tides were then suffered

fered to flow over its top, strengthening and consolidating the work into so compact a mass, that there has been little or no settlement in the bank, which now presents a firm grassy surface; no vacancies being perceptible between the sods, though it has experienced all the vicissitudes of weather. A ditch was cut on the land side, which furnished part of the materials for the bank, and the rest were taken from the surface of the river side, at a proper distance.

The work was performed in the months of September, October, November, and December; notwithstanding the frosts that then prevailed. The contractors were allowed eighteen months to finish the undertakings, but by diligence, and by employing many hands, the whole was accomplished, and the tides effectually excluded, within sixteen weeks. They were so confident of success, that they agreed to insure against all accidents and repairs during three years, for the moderate premium of 100*l.* Hitherto they are under no apprehension of the failure of the works. They have seen some unusually high and stormy tides beat against the bank to within a very few inches of its top, without doing the slightest damage, and it has now stood through one winter. Until this improvement the land would not have let for more than 5*s.* *per* acre, the herbage being of no value for a great part of the year: it was much intersected by ravines and holes formed by, and generally full of water; but in consequence of this embankment, I consider the land thus recovered (even in the present depressed state of agriculture) well worth from 40*s.* to 50*s.* *per* acre, without any further expense being incurred by the landlord.

Much land in this neighbourhood may be recovered or greatly improved by similar means; and if these facts should be thought to bring the case within the class 42,

in

in your list of Premiums, and thereby promote the circulation of information through your valuable Transactions, it may be hoped that others will be encouraged by the manifest advantage of this undertaking.

We the under-signed having made enquiry into the general state of facts above set forth, do certify the same to be true. Dated this 19th of June 1816.

DYNEVR.

THOMAS FRANKLEN, a Magistrate for the County of Glamorgan.

EDMUND THOMAS, Curate of Britton Ferry.

The facts above stated are within my personal knowledge, and I beg leave to bear testimony to the correctness of the statement. GEORGE TENNANT.

Gray's Inn.

Description of a Machine for freeing the Shaft Horse, when fallen with a loaded Cart.

By Mr. W. AUST, *of Gray's Inn Road.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal and Fifteen Guineas were voted to Mr. AUST *for this Communication.*

I BEG to lay before the Society a machine lately invented by me, for raising loaded carts, drays, and any two-wheeled carriage, in the event of the shaft-horse falling. The first machine was tried at Messrs. Calverts' and Co. Upper Thames-street, in the presence of Matthew Wood, Esq. Lord Mayor of London, John Foster, Esq. of the firm of Messrs. Calverts' and Co. and

and several other gentlemen, on Monday, the 30th of December, 1816: the above gentlemen were fully satisfied, as the machine raised up a dray, with three butts of beer, in an instant. The Right Hon. the Lord Mayor gave an order for several of them to be placed about the different districts of the City for the áccommodation of the public. The above machine is calculated to raise any two-wheeled carriage, in case of the shaft-horse falling, in any situation that it may, with ever so heavy a load. The machine is not very heavy, the weight 22lb. and is made conveniently to fix upon the shafts of the two-wheeled carriage, so that there is no difficulty in its being immediately applied by the drayman.

The instrument consists of the simple addition to the common props of the cart, of an iron bar and hook about half their length, attached to the top of each prop, and a bent iron prong at the bottom, to prevent their slipping; the props are strengthened with an iron ferrule at each end.

When a horse falls, the props are taken from their usual fastenings, and placed with the hooks attached to the shaft ends; the fore-horse chains are then hooked in the loops at the top of the props, and as they stick in the ground when he pulls, he raises them perpendicular, and they pull the shafts up after them; the horse's power on the props increases as they become more upright, which is essential, as it gives the best help to the fallen horse when he is about to rise. When the props are slung to the shafts, the hooks remain in the same rings of the shafts in which they would be put for action, and the props support the shafts on their own top as though the bars and hooks were not there, so that there is no inconvenience; the bars are not in the way, and their addition is not perceptible.

Comments

Comments on the general Mode of raising and managing Fruit Trees of the Nurserymen.

By JOSEPH HAYWARD, *Gent.*

From the SCIENCE of HORTICULTURE, &c.

IN the removal or transplantation of trees, gardeners and nurserymen are generally very careless and inattentive in taking them up, and care not how much the roots are broken or lessened in number, provided they have enough left to keep the tree alive; the consequence is, that although the branches left on may remain alive, there is so great a deficiency of sap, from the loss of roots, that the vessels cannot be filled the following Spring, therefore they contract and become inflexible, and after one or two seasons are incapable of extension; so that when in the course of time the roots are restored, and the sap supplied in the usual quantity, it is, from being restricted in its former course, impelled through the nearest vertical and accommodating buds that offer.

Hence it will be seen, that in almost all trees trained in the common way, the first branches which were trained in, and are the most horizontal, are the smallest and weakest, and in consequence incapable of bringing fruit to perfection; and as these occupy the best part of the wall, the strongest and most luxuriant shoots, by being trained erect, quickly grow out of bounds, and are annually cut away.

Thus the strength of the tree is wasted, and the continued efforts of Nature to produce fruit, in proportion to the age and capacity of the roots, is obstructed, instead of being forwarded and assisted.

It is this effect that induced the practice of heading back young trees, on transplanting; and under such circumstances it is certainly a proper and necessary method.

Trees that are not headed back, after the usual mode of transplantation, such, for instance, as half trained and full trained trees from the nurserymen, are found to throw out their strongest shoots immediately about the stem or trunk, and notwithstanding these are removed, this and every other attempt to force the sap into the old branches is vain, its nature will remain the same; and a vigorous head cannot be restored, but by a removal of the old branches.

This shews the impropriety of the present practice of heading back and training trees in the nursery-ground.

As it is a general custom for those who plant fruit trees to rely on the nurseryman for the production of their plants, it becomes an object of the greatest importance to enquire, how far their general practice is adapted to public utility. And I feel no hesitation in stating, that this business is conducted upon such imperfect principles, that it is almost impossible to find one plant in twenty that is worth transplanting.

It is obvious, that unless the original plan or foundation be good, a perfect superstructure cannot be raised.

From the deformity and disorder produced in the nursery ground, almost all our gardens and orchards exhibit in their trees a complete contrast to the beautiful simplicity and bountiful produce provided for by Nature.

Before, therefore, any thing like perfection can be attained by the gardener, a reformation must take place in the practice of the nurseryman.

The

The first operations of the nurseryman I will consider to be the transplanting his stocks for engrafting and budding, and in performing this, his only object is, that they grow and produce some kindly-luxuriant branches; but as to how or where, or in what manner, either these or the roots may grow, he is perfectly indifferent.

Whether the bud or graft produces one or more shoots it matters not, the whole are cut off short, or, as it is termed, headed back the following winter, and such as accidentally produce four or five branches, so placed as to be fastened, to form a flat side, are fixed to stakes or a wall, in the form they are usually trained; and as if further to insure premature old age, decrepitude, and deformity, they are afterwards several times taken up and transplanted in the same careless manner.

The roots are broken or cut off at random, and generally either diminished more than one half, or they are doubled back and distorted, and if there be enough left to keep the plant alive, it is thought quite sufficient; and by these means the appearance of blossoms and fruit being prematurely produced, those stinted and deformed plants are sold as half, or full-trained trees for four times the price of others; and when sold, they are again taken up, and the roots treated and diminished in the same careless manner.

Miller, Forsyth, Knight, and others, uniformly direct that trees from the nursery-ground be cut down, or headed back, to two or three eyes, the next spring after planting; and with such plants as are here described, there cannot be a better mode of treatment; but this is evidently losing time, and wasting its produce.

Whenever the roots of a tree are diminished on transplantation, the supply of sap must be proportionally less-

ened; for if the branches of a tree, under such circumstances, are left at full length, the sap vessels, for want of a due quantity to distend them, become bark-bound and inflexible; and when the roots are restored, and furnish a luxuriant quantity of sap, this, from being obstructed in its former channels, forms new ones through the buds that offer the most perpendicular position, next the stem or trunk; and although these shoots may be rubbed off, still they form again in the same place, and it will be in vain to attempt supporting the original branches.

A regular head cannot be formed, but by a removal of the entire old one; and frequently the vessels of the trunk itself become so fixed and stubborn in the bark, and particularly in standards, as to force the sap out into luxuriant branches near the root.

It has often been made a question, and a subject for argument, whether it is better to transplant from a rich to a poor soil, or the reverse; but as the transplanting from a rich to a poor soil, even were the roots entire, must cause the bark or sap-vessels to contract, for want of the usual supply of food, and be productive of the same consequences as curtailing the root, the doubt is easily solved.

It may further be remarked, that however diminutive a plant may be from poverty, provided the vessels have always been free from contraction, they will readily expand through all the usual channels, and receive and regularly dispose of every additional supply of sap, however great it may be.

On

On Soils, and the Preparation of Beds, or Borders for Fruit Trees.

By JOSEPH HAYWARD, *Gent.*

From the SCIENCE of HORTICULTURE, &c.

WHEN the soil of a garden wherein fruit trees are to be planted is not naturally conformable or congenial to the first principle, it must be made so.

The forming new beds or borders will perhaps be thought too troublesome and expensive, but it is of the utmost importance in determining the future produce of the trees, and it should be considered that this first expense is not like common manuring; it will never require to be repeated, and although at first it may appear great, yet if it be divided, and placed to the account of so many years, as its profitable effects will be experienced, it will bear no comparison with every other expense attending the planting and training trees.

As to any particular form or substance of which walls for sustaining fruit trees should be built, I do not consider it of any very material consequence; it however is of material importance, that the top of the wall be so formed as to throw off water; for otherwise it will generally be damp, which renders the trees unhealthy; and when the substance, against which the branches are fixed, is dry, the temperature on all sides will be more equal.

In preparing beds or borders, due attention must be paid both to the soil and subsoil, as each equally affects the health and fruitfulness of trees, and principally as it retains or discharges water, stagnant water being at all times particularly detrimental to the fructification of trees.

If

If the elevation and composition of the substratum be such as to prevent a lodgment of water, and the soil on the surface be a good working loam, it will require little or no alteration, and the trees may be planted in it from nine to twelve inches deep; but if the situation be low and wet, or the substratum of a nature to retain water, means must be taken to prevent the roots from running into it.

In the first place, therefore, where the situation will admit of it, drains must be made to take off and prevent stagnant water; but if this cannot be done, the borders must be raised above it, and in either case, a sound bottom or substratum must be formed at the depth of eighteen inches, or two feet, of such materials as will prevent the roots from penetrating, or water from rising through it, and this must be laid sufficiently shelving to admit water to drain off; and along the edge of the border a drain should be made to carry away the superfluous water: and this may be done by removing the upper soil to the proper depth, and making a stratum of chalk, lime-stone, or lime rubbish, or either, mixed with ashes well forced together: or a more effectual method will be, to form a kind of floor with stone or bricks; but in this case, the joints must be well closed, with hard binding mortar or cement, as otherwise the roots will penetrate, and render the defence ineffectual.

For peaches, nectarines, &c. a border of ten or twelve feet wide will generally prove sufficient.

In cases where the soil has been too close and retentive, and the roots apt to grow deep, I have found the following composition and formation of beds or borders most effectually to answer the desired purpose.

On the substratum lay a stratum of six inches of the common soil of the garden, and then form a stratum of

about

about six inches for the roots to run and repose in, composed of two-third parts of fine drift sand, (the scrapings of a public road, that has been made or repaired with flints, I have found to answer best) and one-third part of rich vegetable mould, well mixed together; and the better way to perform this, is first to lay on about three inches of the composition, and on this place the roots of the plant, and over them spread the other three inches, and cover the whole down with from nine to twelve inches of the common soil of the place.

Where it is not found necessary to form an artificial substratum, it will be sufficient to remove the soil to the depth of fifteen or eighteen inches, and there form the stratum of the roots, covering it down with a foot or nine inches of the common soil.

This composition or principle of forming borders, will prove in every respect conformable to the nature and supply of the food of plants, and their consequent growth, as before explained; and if it be desirable to force the trees to a luxurious growth, they may be supplied with manure in any quantity; by placing it on the surface of the border, whence it will be carried within reach of the roots, in its proper state, water and the injurious effect of a too great detention of moisture consequent on placing dung in contact with the roots, be avoided; and by forming borders shallow, and placing the roots at a short distance from the surface, trees may be kept fruitful, and within a very narrow space.

A Report

A Report on the Cultivation and Application of the Fiorin Grass.

By the Rev. W. B. Barter.

From the Letters and Papers of the Bath and West of England Society.

When about four or five years since, Dr. Richardson prevailed on the agriculturists of the united kingdom to listen to his elegant and classical account of the wonderful properties of his favourite Fiorin Grass, or *Agrostis Stolonifera;* with whatever approbation they might view the stile and manner of its introduction, they did not hesitate to express their fears, that the picture had been much overcharged, and that some abatements of strict accuracy might be indulged to an Author, who appeared to be actuated by so strong an enthusiasm, even of doing good. Whilst one party was loud in condemning the very principle of its cultivation, as contrary to common experience, nay, common sense,—another, less hasty, and more open to conviction, thought it their duty to enquire, whether the Doctor's assertions were founded on truth; and principally, whether his own character and respectability were placed beyond the reach of suspicion. When a cloud of witnesses had dissipated both these doubts, all reasoning on the subject was at an end, notwithstanding the paradoxes which the Fiorin seemed to involve. The facts in Ireland had been established; and there was every reason, from analogy, to conclude, that the sister kingdom might not be less benefited by the new discovery. With this view, our Society has, for the two or three years last past, by large premiums, invited experiments to be made on its culture: and success has crowned their efforts, as they have

awarded

awarded two premiums, in two different years, to two of our most respectable Vice-Presidents.

The possibility of raising the Fiorin Grass in England being thus established, the Society now looks forward to its more general cultivation and application; and that nothing might be wanting to attain these objects, it has offered, in this year, to the best Essay or Report on them, founded on the author's own experience, a premium of ten guineas.

Acknowledging myself to have been much stricken with Dr. Richardson's captivating description of the Fiorin Grass, I endeavoured, under his directions, to learn the habits of this extraordinary plant; and for this purpose, in the autumn of 1812, I planted between four and five perches with it, on land worth about 40s. per acre. The plants or stolones were purposely collected from the hedges and ditches of the adjoining grounds; because, in case of success, one objection, at least, to its more general adoption, arising from the difficulty of obtaining plants, might be removed; whilst, at the same time, the most ample prospect of a large return might be presumed, from the great luxuriance of some of the stolones, extending themselves to the distance of six or seven feet in all directions, frequently climbing up the hedges, and almost choaking them with their powerful embrace. The plants were laid in shallow drills, at sixteen inches apart, in the month of October, and lightly covered over with earth. Great care was taken, in the subsequent spring and summer, to hoe between the intervals, and to destroy every species of weed; for on this *sine quâ non* depends all hope of success: very little trouble or expense is required afterwards, as the thick growth of the crop will smother all future interlopers. The general result of my experience from this small breadth

has been, that the produce of a perch, cut after two or three dry days in the beginning of November, weighed 140lbs., which by drying was reduced to 80lbs. or four-sevenths of the green weight. Mowing the Fiorin Grass is much more difficult and laborious than mowing common grass; it adheres so closely to the ground, by means of its hairy roots, which grow at almost every joint, that the scythe is not easily forced under it; and after the cut is made, the weight and entanglement of the swarth is so great, that considerable address is necessary to turn it over, and disengage the scythe. In order to facilitate the mowing, my servant first uses a cutting-knife, with which he perpendicularly separates the Fiorin into strips of three feet breadth, when they are more easily penetrated by the scythe, and turned over. The before-mentioned quantity of 140lbs. per perch will require at least a third greater breadth of land to cock and dry it on, than that on which it previously grew. When first cut, by adhering so closely to the ground, and in so great quantity, neither the scent nor colour is very inviting; the former is, if not fetid, very earthy; the latter, a dark yellow, like hay sodden in the summer with continued rain. In this state my horses will not touch it: to correct, therefore, this evil, the swarths must be well shaken and separated, and put into small cocks; then the greater quantity of rain that falls on it, the more it will be purified, and the fine particles of earth which adhered to the roots will be washed off. One turning at the end of ten days or a fortnight, whether in rain, frost, or snow, will thoroughly prepare it for use; the disagreeable smell will have vanished, and the yellow sickly hue of the stolones will be exchanged for a light grey. In the last year and the present, two happy opportunities, as I thought, were afforded me both in October and

Novem-

November, of drying a considerable quantity of Fiorin; but in this dry state my horses absolutely rejected it, and I began to fear that all my labours had been in vain; when recollecting that it had never been more grateful to them than when eaten full of moisture, just imbibed from rain, I steeped a quantity of this dry and sweet Fiorin in a pail of clean water for about a quarter of an hour, which being offered to them they devoured instantly. It is, therefore, now my practice not to attempt drying it; but after it has been cut about ten days or a fortnight, to bring it from the field as it may be wanted, in all weather, and give it to my two horses, who wholly live on it. The quantity they consume in 24 hours is 50 lbs. each; less, I believe, would suffice them, but my servant, like most other servants, thinks that they ought not to be stinted; they are both, however, in very good condition.

Having experienced so much satisfaction from this small spot of four or five perches, I was determined to extend the plantation to an acre, in the year 1813. It was begun early, in hopes of my being able to furnish our Society with some report of it at the succeeding Annual Meeting. The ground was a good pasture field, worth £.3 per acre, and measured exactly 161 perches, or 1 acre and 1 perch.

In the beginning of January 1813, as the weather permitted, the turf was inverted by a spade to the depth of four or five inches; on the back of it the Fiorin was planted as before, in the months of February and March, at sixteen inches distance, with stolones from my former plantation. Though every care was used in all the several operations, owing to some unknown cause, such a general failure in the growth of the plants began to appear in the latter end of April, and beginning of May,

 that

that it was judged best to plough the whole down, and give the ground a complete summer fallow; which was effected by three ploughings, and four draggings and harrowings. Though this was a grievous disappointment, yet it may not be without its use, as it may warn the cultivator of Fiorin to depend more on autumnal than spring planting. In the beginning of October, the stolones were put into the drills at sixteen inches, as before, and the whole acre finished on the first or second of November. The planting was performed by one woman occasionally, and three or four girls from twelve to fourteen years old; a line was attached to two sticks of sixteen inches length, (the space between the drills,) and being stretched the whole breadth of the field, a sharp-pointed hoe was drawn by the side of it, and made a drill about an inch and a half deep, into which the stolones were laid lengthways, and kept in their places by small quantities of earth heaped on them by the hand. Though both the trouble and expense be increased by this mode of planting, yet the certainty of effectually destroying the weeds in the spring and summer, by means of the vacant interval, will more than compensate for both. The women's and children's labour in the planting cost about £.1. 15s.; the hoeing in the spring and summer of 1814, and replacing some plants which had failed, done by women, cost £.2. 5s. In the last spring and summer it was again looked over, and the weeds that appeared were drawn by hand, at the expense of 15s.; and it now exhibits as clean a surface, and as uncontaminated by weeds of any sort, as could be wished; and there appears little probability of any further expense being incurred on their account.

The value of the crop of last year may be easily ascertained, as my own two horses, besides those of occasional visitors,

visitors, were wholly fed with it from November to May; whereas, during the same period, in the former year, my tenant was paid £.11. 16s. for the hay, at 4s. per hundred, consumed by the same horses: there was besides much given away for transplanting, much trodden into the ground and wasted, from the field having a foot-way through it, and at least half a ton dried and unconsumed, which was mixed with the common hay made in the beginning of June.—The land (if good land be employed) most easily and least expensively applicable to Fiorin is ground that has borne early potatoes, and been cleared before the end of September. If there be any crop that more generally engages the attention of the cultivator, it is that of potatoes, both as to manure and weeding; little more, therefore, need be done, than levelling the ground with a pair of harrows, when the planting of the Fiorin may commence. It has been frequently said, that poor hungry soils, fit for nothing else, are alone adapted to Fiorin; but if my data be true, that land worth £.3 per acre can produce a substitute for hay, for two horses at least, during seven months, with a surplus of half a ton at the end of that period, it will be difficult to find any other *grass* product of equal value: for it should ever be remembered, that in all comparisons of the value of Fiorin grass, they should only be formed between the value of that and of any other species of *grass*. Had I, in the spring of 1813, let my acre of land for raising potatoes, at 1*s*. per perch, which was repeatedly offered me, the whole outgoings of planting and cleaning the Fiorin in the following spring and summer would have been doubly reimbursed; and may be adopted in future, with certain advantage, by any cultivator of Fiorin. It is but fair to acknowledge, that the expense of turning my land first by hand with the spade, and then giving it three plough-

ploughings, and four draggings, was very considerable: one consolation, however, attends it, which is this, that no one, who may chance to read this Report, will again incur it; and that, "happy is he," as the adage says, "who is made wise by another's misfortune." In the spring of the present year, the acre of Fiorin was lightly covered with six ton of a compost heap of dung and road earth: whether it be absolutely necessary, or not, experience does not enable me to say, but it certainly deserves it, as it affords so large a quantity of produce, from whence manure is made; and there are few crops that are not meliorated by the dung-cart. From observing the habits of Fiorin, which grows with the greatest luxuriance in places abounding with water, particularly in the carriages and gutters of watered meadows, there can be no doubt, but where irrigation can be applied to it, its utmost possible produce may be expected.

Though in order to furnish the cultivator of Fiorin readily with plants, Dr. Richardson referred him to the ground under the north wall of his parish church; it still seems probable that there is some difference between the specimens found in that situation, and those with which the Doctor has favoured many of the members of our Society. The stolones in Sir J. C. Hippisley's field, and those on Leigh Down planted by Mr. Miles, both from Dr. Richardson, were much larger and longer in their stolones and leaves, than any which are indigenous in our own neighbourhood. Whether the greater nutritive quality, or superior quantity, be in one or the other, I am not enabled to judge; but it is my firm belief, that the least productive of the two furnishes sufficient encouragement for its propagation. It is not an easy task to ascertain, with exactness, the weight of a perch of green Fiorin, because so much depends on the quantity of

of moisture it may at that time contain; the same perch, cut in a drying easterly wind, and weighing only 140lbs. would, in consequence of a shower that lasted not half an hour, be increased in its weight 20lbs. or 30lbs.; or, should a severe frost overtake it, such is its exsiccating quality, that, in less than 24 hours, it will be reduced to 90lbs. or 100lbs. Still all these different meteors do it no injury; frost, snow, rain, and hail, find and leave it in the same edible situation. During the snow of last year, which continued about a week, a farmer passing by my Fiorin field, and curious to discover what rational employment my servant could possibly be engaged in, expressed the greatest astonishment on being informed, that he was only raking the cocks of Fiorin together, which just emerged above the horizon of the snow, that he might carry them home in a cart to his master's horses.

The Fiorin, being an aquatic plant, grows most luxuriantly in wet weather, and continues its growth till the end of November, and sometimes a little longer, unless checked by the frost; before that period, the hardest frost only suspends, does not put an end to, its growth. The last autumn has been remarkably dry, which is, perhaps, the reason why my crop of Fiorin, though by no means deficient, has not been so large as might have been expected from so good land, and such good cultivation. There was one feature attending the Fiorin of this year, which it almost wholly wanted in the last,—a most beautiful fleece of panicles, of a reddish brown colour, equally covering and waving over the recumbent grass. It is a well-known property of some plants, that, by being suffered to drop their seed, they lose some portion of their future strength; and such, possibly, might have been the case with my crop, as a multitude of thin

white

white effete stalks were cut and intermixed with the stolones. A portion of the Fiorin field was purposely omitted to be mown till early in last March, but no other inconvenience appeared to accrue from it, except that the plant was not so succulent, and the roots at the knots much elongated; it would therefore, perhaps, be more prudent not to defer mowing to so late a period, as exposure to the weather never injures the crop.

Though I have exhausted all my memoranda of the Fiorin, as applicable to the stable, I am fully aware that the Society's views were directed also to the dairy. Cows I have none; but to shew my readiness, as far as I am able, to comply with their expectations, I have prevailed on a neighbouring amateur to tie up one of his cows for a week or ten days, and ascertain the produce of her milk on his best hay; and then to feed her for an equal portion of time on my Fiorin, and to favour me with the result. The hay trial is ended; that with the Fiorin began last Wednesday night, the 6th instant. The final result, when known, shall be communicated, and form the concluding part of this report.

Though I had been three or four times to see the success of the Fiorin experiment with my friend's cow, and had heard from him most of the particulars, yet that the strictest justice may be done it, I shall transcribe his own account of it just sent to me.

"I have felt a very considerable degree of interest in the result of this experiment on the effect of Fiorin on milch cows, and have given the strictest directions in my power that every attention should be paid to its accuracy. The outset of your experiment augured the most complete success. You have been told that the cow, when the Fiorin was first presented to her, did not notice it; but having tasted, ate it with the greatest avidity,

avidity, and would not be induced to return to the very good hay she had before been fed with. This disposition continued for two or three days, and the milk certainly rather increased, when she lost this keen relish, and with all the attention that could be given to the subject, has never recovered it. May not this have been dependent on some accidental circumstance, and not on the general effect of Fiorin? I regret that you left your experiment so very late, as to preclude all possibility of revision or correction of real or supposed errors.

" *Result of Experiment.*

" Ten days fed on particularly good two-years old hay. Milk, average per day, ...	13 pints.	
" Ten ditto on Fiorin, ditto	11 ditto.	
	lbs.	*oz.*
" Weight of *hay milk* per pint, during the above time	1	$2\frac{1}{4}$
" Ditto of *Fiorin milk* ditto	1	2

" The flavour of the Fiorin butter was certainly superior to the hay butter, and it was also sweeter; at least this was the united opinion of my family.

" Average quantity of hay daily	33 *lbs.*
" Ditto of Fiorin..............	50

" I would direct your attention to (what appears to me) the great disproportion in consumption; and whether the small proportionate quantity of Fiorin does not point out some not generally existing cause. The cow is a very large and a very hearty one."

Such is my friend's plain and sensible account of the success of his experiment for ten days; but as he is a great invalid, and could only give directions for the proper feeding the cow, if any prejudice, arising from the novelty of the subject, or the dread of more personal

 trouble,

trouble, existed in the minds of the labourers, to whom that office was assigned, we need not look far for the cause of the cow's altered appetite.

An unusual pressure of engagements prevented me from attending earlier to the cow experiment; but if my valuable friend will lend me his further assistance, it is not yet too late to repeat it, and to communicate the result to the Society at their February meeting.

It is now my intention, as I have this year submitted to the Society a report of my experience of the Fiorin Grass, to continue yearly a register of such new observations on its produce and uses, as may be thought interesting to the public, and communicate them to the Society in any form which they may please to direct.

On the adapting of Plants to the Soil, and not the Soil to the Plants. By Mrs. AGNES IBBETSON.

From the LETTERS and PAPERS of the BATH and WEST of ENGLAND SOCIETY.

IT has long been my intention to address a letter to that Society, who several years past honoured me with what I considered as the most flattering and highest proof of their approbation: but constantly occupied in dissecting and studying *the nature of plants,* I was perpetually prevented fulfilling my wishes; but within the last few years, having endeavoured to draw *results* from the *dissection* of vegetables *applicable* to *agriculture,* and having the use of a pretty large farm to assist theory by practice, I shall, with the greatest pleasure, dedicate my future services where gratitude should lead me to offer them, if any thing I can write can possibly be acceptable to so eminent and learned a Society.

I have

I have been lately much employed in endeavouring to shew that all plants should be divided, disposed, or placed, according to the different soils, congenial to their habits, from which they originally proceed; and that it is to the total inattention to this circumstance, that we probably owe the very strange and contradictory results constantly to be found in all agricultural reports. No person can read with attention the late accounts delivered to the House of Commons, respecting the growth of corn throughout this kingdom, without being struck with the contradictory returns transmitted of the whole; and without being convinced, that there must be some hidden cause for such a strange diversity in the gains of the *farmer:* as there are many instances adduced, in those reports, of the same excellent management, where the same seed has been sown, an equal degree of labour performed, with the same *season, time, and manure,* employed, and one farmer has gained three times as much again as was expended for putting in the crop, while *another* has scarcely exonerated and repaid himself for the labour and seed: what then could be the cause of the loss of the latter, and gain of the former? It must, I am convinced, be attributed chiefly to the agreement or disagreement of the plant with the soil in which it is placed, its situation, and aspect; three things, of which the farmer knows but little, or ever takes into his calculations. He has but one way of putting in plants, *loading the earth with manure.* But to adapt the plant to the soil from which it originally came, to *suit* also the *manure to both,* that they may exactly agree, and not injure the vegetable; that the situation of the plant may be consulted, with respect to humidity and dryness; and that, to complete the whole, the *aspect* also may be fitted, so that the plant that *loves* the *sun* may be exposed to it,

while that which prefers shade may receive it:—these are attentions truly wanting to our agricultural system, as I hope to shew.

It has been a subject of considerable enquiry among agriculturists, as in what consists the food of plants. Some have attributed it to water, some to earth, and others to air. To all these sources vegetation is indebted; the fertilising principle of all manures is referable to the extractive matter arising from decomposed animal and vegetable recrements, and in this state soluble in water, which is the carrying medium into the vegetable substances. Vegetables will not grow in pure earth, or pure water: some plants are so organised as to require only mechanical support from the soil, abstracting their nourishment from the atmosphere by means of their leaves; whilst others from their roots depend upon the soil for their support. Although many plants will grow in different soils, yet they have all their favourite ground; and it is more easy to accommodate the plant to the soil, than to adapt the soil to the plant. By knowing, therefore, what sort of plant the farmer is going to put in, he may of course be regulated with respect to the quantity and species of manure required, the aspect wanted, and the degree of humidity and dryness requisite for the plant. All plants came originally from a peculiar earth; either from clay, sand, gravel, chalk, or loams formed from a mixture of some of these, or from a very wet or dry soil; and though many plants will grow indifferently in several species of earth, yet they have all their favourite ground, *that* which they *evidently prefer*. Now to make the soil fit for the plant, is certainly a very expensive thing; but to adapt the plant to the soil is not only an easy, expeditious mode, but one which requires infinitely less assistance in dressing, labour, seed, and

care

care of every kind. It is true that all cultivated plants demand some manure, because nature gives not salt and oil *enough,* in *any earth,* to do without *some assistance* of this kind; but the plant that is natural to the soil requires infinitely less than that which is adverse to it, and may therefore be cultivated at a quarter of the expense. Now nàture is so bountiful, that there is scarce a plant necessary to the food of man and animals, that, if we choose to seek it with care, has not *one peculiar sort* calculated for *every soil.* Thus in clovers, there is a sand clover, a clay clover, a gravel, and a chalk, clover; one that grows well in rich lands; and one that would be ruined in a good soil, and can grow and do well only in a poor one; one that will not endure moisture; and one that only grows in wet land; one that prefers hills, and one that will grow in vallies alone; one that likes the sun, and one that covets shade. Nature has been equally bountiful in most other plants peculiarly adapted to *agriculture,* and in which there are *quite as many species* fitted for *poor land* as for *rich ones;* and, if planted in their own soils, give an infinitely *greater return,* and are not subject to those *dreadful disorders* but *too common* to plants placed in improper ground. I have repeatedly traced maladies arising from this source*, that afterwards tainted the very means of life in a vegetable: and being constantly accustomed, when I heard of any extraordinary crop, to proceed to the place, and enquire thoroughly into the cause and management made use of by the farmer, I have generally found the success to proceed from accidentally putting the plant into that ground from which it originally issued, and manuring it according to the quantum of juices it received from the earth, and with that matter likely to form a proper compound adapted to its wants; in short, attending to the right

rules

rules of vegetable economy, and the common process of nature.

But I am sorry to say, that, in examining innumerable farms, *diversely situated,* I have but too often found this order reversed; the chalk plant put in sand, the sand plant in clay, and so on; and, what is still worse, the watery plant put in dry ground, and the dry vegetable in a wet soil; and in all these cases they cannot fail of making a very bad crop. A plant accustomed to a poor soil, placed in a good one, *rots;* while the one that prefers a *rich loam* is *starved* in *a poor one.* A clayey plant put in sand is blown out of the earth, for want of those *retentive powers* the root is used to; while the sand plant, placed in clay, decays at the root from the under moisture which it cannot bear. The chalk plant, also placed in gravel, is destroyed by its own *acidity,* which is *no longer subdued:* for most plants (if the farmer do not grudge the making the soil) he may certainly do it, but it can never answer in point of expense. It is a strange mistake, and a most fatal one, that almost all, even *some* of our *best, gentlemen farmers* fall into, viz. that they cannot manure *too highly.* Now this is so completely the cause of innumerable failures, that I am most anxious to censure the practice. It always reminds me of the account given by Miller, of what was done in the West Indies, when some botanists were desirous of bringing over some fine plants of the *cactæ species.* They enquired not what the plants *were,* but wholly inattentive to their being *rock plants,* they put them into tubs of the richest soil they could procure; the *plants all died:* but this was looked upon as accident, and the same process again followed, when one of the casks breaking, they concluded the plants must die, as the earth had left them; and flinging on them some dry sand, which happened to be in the

way

way, ordered the cask down to the hold, when to their great astonishment the plants so treated *lived,* while those in the other cases died, as usual. This opened the eyes of the gardeners with respect to rock plants; but to this day sand plants, instead of having a poor soil, generally receive a rich one. There is not a more ruinous effect than that produced on the plant of a poor soil placed in rich ground. Some time since a gentleman brought me some turnip roots that had in the same manner failed for several years; and the potatoes had equally been vitiated the preceding year. It is, I find, a *common disorder,* in *gardens* especially, and all *rich ground.* When I dissected the plant, I found the wood or sap vessels of the root were rotted off, and in their stead a number of large bladders of putrid water remained, as a sort of swelled and distorted root. But almost all nourishment from the earth was suspended, and the leaves alone retained a sort of life, from the nutriment they received from the atmosphere, while the washy and putrid effects, the consequence of nutriment, seemed to poison all the rest. The potatoes were nearly in the same condition, the roots all decayed, nor forming any bulbs: but when *peas* or *vetches* were placed in the same ground they grew remarkably well. Now this is *certainly* a proof that a plant can be destroyed by a decided aversion to the soil in which it is placed; which will, notwithstanding, admirably agree with many *other vegetables;* and that the plant of a poor soil can be as much hurt in a rich one, as the plant of a rich in a poor soil.

TO BE CONCLUDED IN OUR NEXT.

Process

Process practised in the Establishment of Syoise Sur Seine to extract Vinegar or Acetic Acid from Wood. By M. P. L. DUPUYTREN.

From the JOURNAL DE PHARMACIE.

AT the extremity of a large building calculated for the purpose, are four furnaces, adapted to receive large retorts, the lower parts of which are made in cast iron, and the rest in strong iron plates; at a small distance from the bottom of these retorts is the opening of a copper pipe of three inches diameter, which rises through the metal of the retort, and widens like a tunnel at the upper end; a copper cylinder eight or nine inches wide, and eighteen or twenty long, is fixed to this tunnel, passing out of the building, is bent downwards, and is plunged into a large tub full of water, which is constantly renewed; from hence it discharges itself into a condenser, to which are adapted on one side a small cock to carry off liquids, and on the other a cylinder of about the same bore as the one mentioned above, and which rises vertically, then turns down and enters into the building, where it is again bent, and opens at the hearth of the furnace.

This apparatus being put together, the retorts are filled with pieces of wood which have been cut a year, and which must be chosen straight and long, and about as large as the wrist; these pieces are arranged in the retort with order, and when the retort is full, it is covered with its lid, which is fastened on by means of screws; it is then luted with an argillaceous earth, and by means of a crane two men raise it up and place it in its furnace: over this is put a covering of masonry of considerable weight; the cylinder is fitted to the retort, and the fire is lighted.

All

All the water which is in the wood soon dissipates, and the carbonization begins. Then there is disengaged much carbonic acid; acetic acid combined with water; carbonated hydrogen, and an oily matter similar to tar, with perhaps a small portion of carbonic acid gas.

In some part of the retort in which the decomposition is made, all these matters are forced to pass through the entire mass of wood to get to the opening of the pipe before-mentioned, which is purposely placed at the inferior extremity; by this pipe they enter into the copper cylinder which conveys them to the condenser; there almost all that is water, the acetic acid and oily matter become condensed, and run off through the little cock; while all the carbonic acid, the carbonated hydrogen gas, carbonic acid gas, which also carry with them a small quantity of the other products, rise up by the other cylinder, and go into the fire, where they serve as combustible.

When this operation has continued five hours, by means of a cock these inflammable vapours are directed under the fire of another retort, of which the fire is just lighted. The heat of the first furnace and that which escapes from the wood during its decomposition being sufficient to complete the carbonization of all which is contained in it without the aid of the combustion of the gas. It is not necessary even to wait till the evaporation of these vapours has ceased before the tube is removed from the ash-pit of the first furnace, because the charcoal would be too weak.

When the neighbouring retort begins to give out its gaseous products, and can do without further assistance, the pipe is removed from the ash-pit, and the remaining gas which comes out is set fire to in order to prevent the disagreeable smell arising from it. The flame thus pro-

duced is as large as the pipe, rises many feet above the pipe, and lasts about half an hour.

The moment the retort is removed, it is re-placed by another, and the same process is observed as with the former.

Some caution however is required in this process; for the moment the retort is taken out of the furnace, the copper cylinder is filled with inflammable gas; if it is joined and luted immediately to that which succeeds it, the gas will mix with the air contained in it, and the very smallest spark that could possibly penetrate the fissures of the retort would occasion an explosion, for which reason the apparatus is never to be luted, till the very instant the empyreumatic vapour begins to appear.

The retorts are from about seventy-two to a hundred cubic feet in capacity. They contain one and a half to two loads of wood, which when it is well chosen and of a good quality, will yield twenty-eight *per cent.* of charcoal, and yield two hundred and forty to three hundred litres of pyroligneous acid, containing one-twelfth of tar.

The charcoal retains the form of the wood; it is intermixed only with a small quantity of dust which proceeds from the bark; it possesses all the qualities of good charcoal, but its combustion is more rapid and more brilliant, and less is required for raising liquors to boiling heat. If exposed in contact with the air, it gains ten *per cent.* in weight.

Hard woods give the most satisfactory results; but white woods are rejected, it takes five or six hours to char the wood, and seven hours to cool the charcoal.

When the retort is taken out, the pyroligneous acid is

a red-

a reddish semi-transparent liquid, and of a strong empyreumatic acid taste and smell; every hundred parts will saturate as much subcarbonate of alkali as seven and a half to nine and a half of sulphuric acid will concentrate; and marks five to six degrees of Baumé's hydrometer.

It flows from the condenser in a continual stream, of the size of a goose quill, and is conducted into a large wooden cask placed in a cellar, where, in cooling it deposits the greater part of its tar; from hence it passes into another cask where it remains in store.

In this state it is preferable to vinegar for all kinds of dyeing and printing on linen; it possesses an oil which is an excellent mordant for linen and cotton, and prints with a more brilliant, durable, and fine colour. It likewise serves to give a rose colour to woods, feathers, and straw, &c.

To separate the acetic acid from the empyreumatic oil, which colours and changes its nature, it is run into a large iron cauldron, where as much sub-carbonate of lime is added as it can decompose when cold. When it is arrived at this point, a certain quantity of the tar which floats on the surface is taken off with a skimmer, and by means of a pump the liquor is raised up in a cauldron, where it is then boiled. The saturation is then continued with quick-lime, and decomposes the acetate of alkali which remains in dissolution; and the sulphate of lime which precipitates, carries with it a fresh quantity of tar.

When the deposit is accomplished, the liquor is passed into another cauldron, and there it is concentrated by a slight boiling till a thin skin arises, then it is put into wooden tubs where in cooling it becomes solid.

This production is extremely impure and black, in consequence of its retaining some portion of oily matter.

This foreign substance resists repeated crystallisation, and cannot be taken away except by melting. These impure crystals are therefore put into a cast-iron cauldron, where they undergo the aqueous fusion; all the water that they contain is evaporated, and when they are dry, the fire is increased till all the matter is in a burning fusion. It is then run into appropriate squares, in which it becomes solid.

In this state it is black like coal, but it easily dissolves in warm water, and this solution filtered and stirred with care gives crystals of acetate of alkali, which retain scarcely any of the empyreuma. It is then melted in a certain large quantity of water, and it is decomposed by means of sulphuric acid of commerce; it then gives out sulphate of alkali crystallised, and acetic acid, which only remains to be distilled to get it perfectly pure.

This distillation is carried on in large stone pitchers, called tourilles.

While the burning fusion is going on, only a small quantity of acetate of alkali is decomposed, which depends probably on the presence of the oily matter.

This acetic acid, thus rectified, shows eleven degrees on the hydrometer of Baumé.

It is to be preferred to distilled vinegar, as the latter is never so concentrated, and always retains some portion of vegetable matter which injures the beauty of the productions; besides which, for all preparations to be done with the acetic acid of wood, it does not require to be purified.

It is easy to concentrate this acid to a proper state for crystallisation; it is sufficient to combine it with acetate of lime, and to decompose this salt slightly calcined, by concentrated sulphuric acid.

At the instant of contact the re-action is extremely rapid,

rapid, and the acetic acid is disengaged, giving up to the sulphate of lime all the superfluous water.

The mother waters from the first and second crystallisation of the acetate of alkali are no longer susceptible of giving fresh crystals by evaporation. As that, no doubt, depends on the too great quantity of oily matter which is in it, it is probable that by calcining them alone, or with a mixture of charcoal powder, or perhaps by making them boil with charcoal, that they might again acquire the properties of crystallisation.

However that may be, they are evaporated to dryness, are mixed with tar, and then serve as fuel to heat the cauldrons. But as the cinders from them are not quite deprived of the acetate of alkali, they are passed through a reverberating furnace, washed in lye, and by the second crystallisation the finest sub-carbonate of alkali is procured.

A new Process for making Vinegar.

By M. Schaedelin.

From the same.

I put into a cask of about one measure in capacity, a mixture of twenty litres of water; four litres of brandy from grain; a philogramme of yeast, and the same quantity of powder charcoal of beech-wood. I conducted the fermentation as usual, and in about four months I obtained a very strong vinegar as white as water.

I made from it a very fine acetate of potash, by redissolving it in four times its weight of water, which I put into a glass bottle covered with blotting paper. In three weeks the solution was covered with a thick mouldiness, which I separated by filtration.

This

This solution, which was become a little alkaline, when saturated with distilled vinegar and treated with powder charcoal, gave a foliated tartareous substance white and very strong.

If the time required for acidification were not so long, it might become a very lucrative concern; but experience has taught me that to make it saleable we should give it a vinous colour; for such is the prejudice of many, that vinegar must be yellow to make it acceptable.

List of Patents for Inventions, &c.

(Continued from Vol. XXXII. Page 384.)

AUGUSTUS APPLEGARTH, of Nelson-square, Great Surrey-street, Surrey, Printer; for certain improvements in the art of casting stereotype or other plates for printing, and in the construction of plates for printing, and in the construction of plates for printing bank or bankers notes, or other printed impressions, where difficulty of imitation is a desideratum. Dated April 23, 1818.

EDWARD LILLIE BRIDGMAN, of Goswell-street Road, St. Luke's, Middlesex, Tallow-chandler; for certain improvements in making coffins, and in machines for conveying coffins for interment, and appendages to the same in the church and burial grounds. Dated April 23, 1818.

GEORGE TYER, of Homerton, Middlesex, Gentleman; for a chain-pump. Dated May 2, 1818.

JOSHUA ROWE, of Torpoint, Cornwall, Merchant; for certain improvement or improvements, or process or processes applicable to the printing of cotton and other cloths, and to other purposes. Dated May 4, 1818.

Sir THOMAS COCHRANE, Knight, commonly called Lord COCHRANE; and ALEXANDER GALLOWAY, of Holborn,

Holborn, Middlesex, Engineer; for the working or making a manufacture, being a machine or machines for removing the inconvenience of smoke or gases generated in stoves, furnaces, or fire-places by the ignition or combustion of coals or other inflammable substances, and in certain cases for directing the heat, and applying such smoke or gases to various useful purposes, which will be of great public utility. Dated May 4, 1818.

Thomas Jones, of Bradford-street, Birmingham, Warwickshire, Iron-founder, and Charles Plimley, of Birmingham aforesaid, Refiner; for an improvement to blast engines and steam engines. Dated May 7, 1818.

William Bush, the younger, of Bermondsey, Surrey, Engineer; for an improvement in the method of drying and preparing of malt, wheat, and other grain. Dated May 5, 1818.

Wolf Benjamin, of Plymouth-dock, Devonshire, Umbrella-manufacturer; for a composition varying in colour, with a peculiar method of applying, for the purpose of rendering canvass, linen, and cloth durable, pliable, free from cracking, and water-proof; and also for preserving every kind and description of wood from wind or weather, whether applied to ships, houses, or manufactories, and for all purposes where paint, varnish, or tar are used for the purpose of preservation or beauty, and whether applied to cannon or iron of every description. Dated May 5, 1818.

Thomas Todd, of Swansea, Glamorganshire, Organ-Builder; for certain improvements in rolling of iron, and making wire, nails, brads, and screws. Dated May 7, 1818.

William Church, of Turner-street, Commercial-road, Gentleman; for certain improvements in or upon the

the machinery for making nails and spikes of various forms and dimensions, and also wire and screws of iron, copper, brass, or any other suitable metal. Dated May 7, 1818.

Henry Constantine Jennings, of Carburton-street, Fitzroy-square, St. Marylebone, Middlesex, Esq.; for an improvement in the mariner's compass. Dated May 7, 1818.

Robert Eccles, of Edinburgh, Esquire; for certain improvements in the masts, sails, and rigging of ships or sailing vessels. Dated May 9, 1818.

Thomas Brown Milnes, of Lenton, Nottinghamshire, Bleacher; for certain improvements on machinery for the finishing of cotton, Angola, and lamb's-wool stockings, and other frame-work goods; also the application of known powers to the working of the said machinery. Dated May 19, 1818.

Maurice St. Leger, of St. Giles's, Camberwell, Surrey, Gentleman; for an improved method of making lime. Dated May 19, 1818.

Thomas Hills, of Bromley, Middlesex, Merchant, and Uriah Haddock, of the City-terrace, City-road, Middlesex, Chemist; for an improvement in the manufacture of sulphuric acid. Dated May 19, 1818.

Thomas Motley, of the Strand, Middlesex, Patent Letter Manufacturer, one of the people called Quakers; for certain improvements on ladders. Dated May 19, 1818.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CXCIV. SECOND SERIES. July 1818.

Specification of the Patent granted to Frederick Dizi, *of Crabtree, Fulham; for Improvements on Harps.*

Dated November 1, 1817.

With an Engraving.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I do hereby declare that my improvements consist in producing from the same string three semitones, by means of a machinery which acts inside of two or more plates between which the strings do pass, and in an index to denote the key in which the harp is; the means by which I carry these improvements into effect, are fully detailed and explained by reference being had to the drawings hereunto annexed, and are described as follows; that is to say: When the instrument is properly strung and tuned without the pedals being acted upon, all the strings are then in the flats; the naturals are produced when the first pressure is applied to the pedals, and the sharps when the pedals are pressed completely down; the pedals act upon two ranges of studs, forks, rings, stops, dividers, or other well-known contrivances, through the medium of seven particular

 pieces,

pieces, which I call levers, placed between the plates near the pillar of the harp. These levers are so contrived, that at the first depression of the pedal the lever affects only the upper range of studs, forks, rings, stops, dividers, or other contrivance; and at the second depressing operates upon the lower range without moving the upper, as the drawings will clearly shew. For the convenience of the arrangement the levers and other parts of the mechanism are placed on two or more plates, through which the arbors of the cranks pass, and on which arbors are fixed the forks, rings, studs, or other contrivance for the purpose of producing flats, naturals, or sharps, at pleasure; these studs, forks, or other contrivance I arrange in the usual manner in two rows, one above the other, so that all the naturals are in the upper range, and all the sharps in the lower range. Fig. 1 (Plate III.) shews the position of the cranks *b* and *c*, and also the lever *d*, when the pedal is out of geer or not acted upon. Fig. 2 shews the situation of the lever, when the first movement of the pedal is made, and also the position of the crank *e*, (to the arbor of which the stud, fork, or other contrivance is attached), in order to produce the natural. Fig. 3 shews the situation in which the lever is when the pedal is wholly depressed, and will move the crank *h*, to the arbor of which is fixed another stud, fork, or contrivance intended to act upon the string, and produce the sharp. Figs. 5 and 6 shew the manner of moving the crank *c* by the crank *f*, which is placed behind or underneath the lever *d*; the crank *f* has a nob or projection *i*, on the upper-side against which the lever presses when the pedal receives its second depression, and causes it to carry round the cranks *f* and *c*, which produces the sharp. Fig. 7 shews the situation which the lever *a*, Fig. 1, will take, when the pedal is first

moved

moved to produce the natural. Fig. 8 shews the situation the lever *d* will take when it receives the second movement in order to produce the sharp; and for the sake of readily discovering without the aid of the ear the key in which the harp is, I fix on the arbors of an octave of the cranks near the middle of the harp, and on the outer-side of the front plate fingers or indexes, on which are marked the musical characters of the notes, and are made to appear in the circles as represented in the drawing, or to disappear, according as the pedals are moved; and by referring to the highest number shewn it will plainly indicate the key; for instance, in Fig. 4, M, the indexes of the strings F, C, and G, are represented as moved in the circles, and therefore by referring to the highest number of the index, which in this case is found on the string G, which is the third in the order of sharps, the harp will be seen to be in the key of A; and I also fix on the arbors of another octave, Fig. 4, N, other fingers in a similar manner, and mark on them the musical characters of flat and sharp; these are intended to indicate the notes which are produced on the strings to which they respectively belong.

In witness whereof, &c.

Specification of the Patent granted to Rueben Phillips, *the Younger, of the City of Exeter, Gentleman; for a new and improved Method of purifying Gas for the Purposes of Illumination.* Dated July 19, 1817.

With an Engraving.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Rueben Phillips do hereby declare, that the nature of my said invention, and the manner in which

the same is to be performed, are particularly described and ascertained in and by the drawings hereunto annexed, and the following description thereof; that is to say: I take any quantity of well-burnt lime, and pour water on it till it falls to powder, I then mix it with a further quantity of water, in order to bring it into such a state that the particles of lime may adhere slightly to each other, but not to such a degree as to prevent the free passage of air between them. This mixture must be placed six inches deep more or less, on moveable perforated shelves in a vessel the top of which is guarded by a water-joint, and underneath is a pipe to allow the passage of the gas that way, so as that the gas may pass from the bottom of the vessel to the top through the perforated shelves and lime mixture, or from the top to the bottom as may be found most convenient, the purification being effected by the gas being caused to pass through the layers of lime mixture; but where the quantity of gas to be purified is very large, I arrange a set of these vessels consisting of five or nine, or more according to the size of the gas-work, each vessel containing one or more shelves. These vessels are placed in any way which convenience may require, but I prefer a circular arrangement described as follows, and which the annexed plan exemplifies. The vessels being without bottoms, stand in a cistern of water or other fluid about six inches deep, so that the gas cannot pass that way.

In Fig. 1 (Plate III.) there are nine vessels, four of which may work alternately; there is also a series of stop cocks in some convenient situation to turn the gas through, either set to the exclusion of the other. Suppose the cock 1, Fig. 1, to be opened, which cannot be done without shutting cock 2, the gas then passes through the vessels A, B, C, D, to the gasometers; and when a renewal

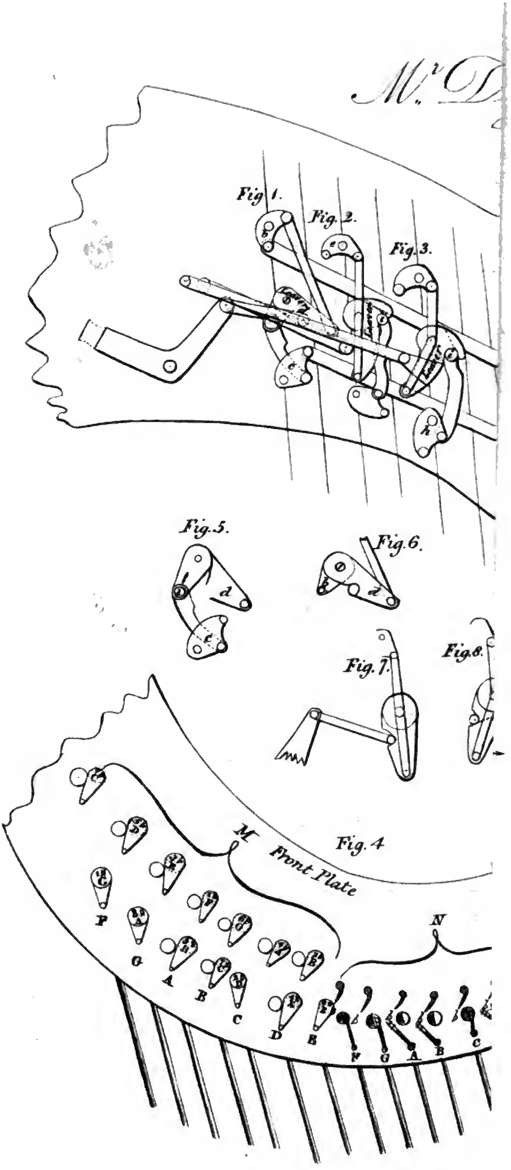


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 4
M
Front Plate
N
F
G
A
B
C
D
E
F
G
A
B
C

renewal of them becomes necessary, the cock 1 must be shut, and by being connected with 2 opens it at the same time, and the gas flows through E, F, G, H; K is an air drain, through which the fire-place is supplied with air, and which is surrounded by a trench filled with water a few inches in depth, and of a sufficient size to allow of a purifying vessel being easily placed within it, so that the current of air may flow down through the vessel, the trench of water preventing the passage of air under the bottom edge. In the centre L stands a crane for lifting the vessels with their contents.

Fig. 2 is a section of four vessels in a straight line, to shew that the gas passes upwards and downwards alter-ternately in the direction of the darts, the upper communicating pipes are secured by water joints, the under ones are firmly fixed, the lime mixture in the vessel that first receives the gas from the retorts will be the first which requires to be changed; the proper time may be ascertained by allowing a little gas to escape from a small cock inserted in each of the covers and holding in the stream of gas; a bit of paper wetted with acetate of lead or any other test for sulphuretted hydrogen. For instance, if the test be slightly affected at the third vessel, the first may be removed, as it may be inferred to have done its utmost in purifying the gas; the renewal is effected by shutting the respective cock and taking off the top pipes. A, the vessel containing the saturated lime mixture, is placed upon the air-drain, B is placed where A was, C where B, and D where C was; I is a spare vessel charged with fresh lime mixture, and brought within reach of the crane upon a carriage, and placed where D was; the top pipes must be replaced and the set is ready to work again. The current of air through A soon clears it from its foulness, when it may be unpacked

and

and charged with fresh lime mixture, and wheeled to the other side to fill the vacancy occasioned by the next renewal.

Fig. 3 shews the cocks upon an enlarged scale, two only of the communicating pipes can be shewn in the figure; the exterior vessel is a cistern of water, the four pipes enter through the bottom and project above the surface of the water, above is a hood counterpoised by the one in the opposite cock. The hoods are divided into four chambers, one division extends to the bottom, the other about half way down the edge is shewn in the figure; the cock A is open and B shut; in A, the two pipes shewn are in communication, the shortest division being above the water, which allows the gas to pass to the purifiers, and return through the two pipes behind to the gasometers; as the longest division is never above the water, the gas cannot pass to the gasomaters without going through the purifiers; in cock B all communication is stopped: this apparatus works without pressure.

In witness whereof, &c.

Specification of the Patent granted to James Ikin, *of William-street, in the Parish of Christ Church, in the County of Surrey, Machinist; for an improved Method or Methods of constructing or manufacturing Fire or Furnace Bars, or Gratings.*

Dated January 27, 1818.

With a Wood Engraving.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said James Ikin, do hereby declare that my invention

invention is described as follows; that is to say: My method of constructing the bar or grating is, in leaving a channel or passage through each bar longitudinally, so that water or any other fluid may be passed through, in order to keep the grating cool, and this may be done as follows. In the first place, by connecting the several bars of the grating together, which may best be done by casting it of iron, in one piece, joined at the ends, and having open spaces between the bars for the admission of the air, as represented by the plan of a set of bars or grating in the drawing.

Fig. 1, the number, length, and depth of the bars, and the width of the spaces between them, and the shape and size of the grating, being regulated by the size and form of the fire-place, where it is to be placed.

And in the second place, in forming a hollow cavity, passage, conveyance, or channel, which entering at one end of the bars of the grating, and being continued through the body of each several bar, turning for this purpose at the ends of the grating, where the bars are united, finishes or ends at another opening. The channel thus formed through the grating is for the conveyance of a current of water, or other fluid, which may be brought from any convenient reservoir (it being necessary only, that it be sufficiently elevated to enable the water or other fluid to force its way through the grating,) by means of a tube made of copper, lead, iron, or other material, to be attached to one of the openings, while another tube, fixed to the other, will carry off the water or other fluid that has passed through the grating.

Fig. 2 represents a cross section of the grating at A B. shewing the hole, passage, or channel, which runs through its several bars.

Fig. 3 gives an end view of the grating, and also re-

presents

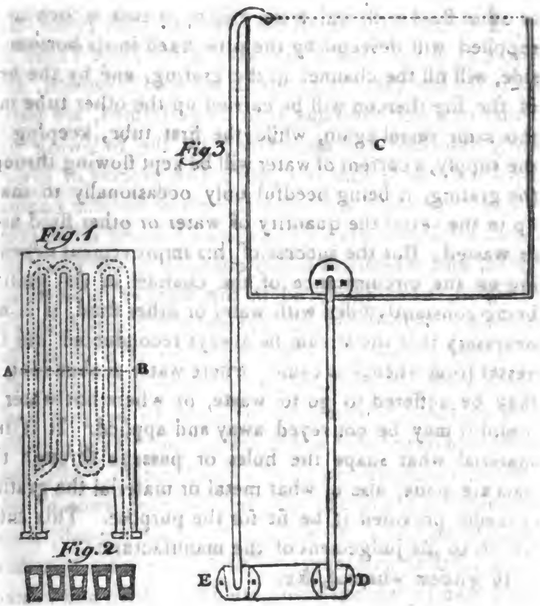
presents one of the ways in which it may be supplied with water. A cistern or cask C is placed at a certain height above the grating. To a hole in or near the bottom of this a tube is fastened, which has its other end fixed to the orifice D of the grating, while another tube, having one end fixed to the orifice E of the grating, has its other end bent over the top of the cistern or cask. The water or other fluid with which the cistern or cask is then to be supplied will descend by the tube fixed in its bottom or side, will fill the channel in the grating, and by the heat of the fire thereon will be carried up the other tube into tho same vessel again, while the first tube, keeping up the supply, a current of water will be kept flowing through the grating, it being needful only occasionally to make up in the vessel the quantity of water or other fluid used or wasted. But the success of this improvement depending on the circumstance of the channel in the grating being constantly filled with water or other fluid, it is not necessary that the stream be always reconducted into the vessel from whence it came: where water is abundant, it may be suffered to go to waste, or where hot water is useful it may be conveyed away and applied. It is immaterial what shape the holes or passage through the bars are made, also of what metal or material the grating is made, provided it be fit for the purpose. This must be left to the judgement of the manufacturer.

In witness whereof, &c.

Observations.

The benefits arising from this invention are very important; first, the grating is so preserved by it that an intense fire will not cause it to burn or to bend, or even to become red; secondly, it prevents the clinkers from adhering

adhering to the grating; thirdly it opposes the escape into the ash-pit of the heat which ought to ascend; and, fourthly, a constant supply of hot water is provided to be used, or not used, as occasion may require.



Specification of the Patent granted to LOUIS FELIX VALLET, *of Walbrook, in the City of London, Gentleman; for the Manufacture of a New Ornamental Surface to Metal or Metallic Composition.*

Dated August 5, 1817.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Louis Felix Vallet do hereby declare that the nature of my said invention, and manner in which the same is to be performed, are particularly described and ascertained by the following description thereof; that is to say; The process of giving the new ornamental surface on metals or metallic compositions, consists in employing those acids and saline compounds, and substances which chemically act upon tin, and which, when employed in the manner to be stated, presently give to the metals or metallic compositions to which they are applied, the appearance of a crystalline surface variously modified; to produce this effect, the metal or metallic composition ought to be previously tinned or covered with a thin coat of tin. If the metal be pure tin, it requires no previous preparation. All grease remaining on the tinned surface in consequence of tinning is to be taken off with a solution of pot-ash, soap, or any alkaline substances. The tin or tinned surface should then be washed with pure water, dried and heated to a temperature which the hand can bear; when the surface has thus been cleaned and heated, any of the acids which act upon tin, or the vapours of these, will cause the desired appearance of crystallisation, but I give the preference to the following composition, which may conveniently be laid over with a brush or a sponge. Take one part by measure of sulphuric acid, dilute it with

with five parts of water. Take also one part of nitric acid, and dilute it with an equal bulk of water, and keep each of the mixtures separate; then take ten parts of the sulphuric acid, dilute it in the manner before stated, and mix it with one part of the diluted nitric acid, and then apply this mixed acid to the tin or to the tinned surface with a pencil or sponge as above directed, and repeat the application of the said composition for several times successively, or until the result you expect proves satisfactory; when this has been done, the crystalline surface may be covered with a varnish or japan more or less transparent and colourless, or coloured, and lastly polished in the usual manner.

In witness whereof, &c.

Some Observations on the Superiority of Gothic or English Architecture to that of Greece, as applicable to the Materials and Climate of the United Kingdom.

By William Taylor, *Esq. of Aukland.*

Sir,

THE scheme that was under the consideration of the late Parliament, and the private subscription in progress for building a number of new churches, may make a call on the attention of the public to a few remarks on the different styles of architecture, not unseasonable.

In almost all the public buildings, which have excited regard and induced to private imitation, the Greek system has long prevailed, nearly to the exclusion of that style which in contempt has been denominated Gothic: while, partiality and prejudice apart, I trust it will appear, upon a fair inquiry, awakened by pointing out a few of the characteristic distinctions, that the latter is productive of more convenience, and capable of being

rendered equally ornamental; which it is hoped will naturally create a wish to facilitate its introduction, by any plan likely to promote the end in view.

The structures from which, what are called, the principles of architecture have been deduced, were buildings of marble, in a warm climate. The nature and strength of marble is such, that it admits of bearings comparatively long; and hence well adapted to the prominent feature of the Greek fabric, the magnificent architrave. Yet, however massive the block, it cannot extend over any great aperture, so that heaviness pervades the whole aspect of a Grecian edifice. But the sun of the country is dazzling, and the air a dust; and shade and coolness become luxuries there: while they are seldom any thing but nuisancies among northern nations, damp and gloomy, where shelter, with fresh air and sunshine, is devoutly to be wished. In short, the Greek architecture is not suited to our country; nor are the materials of our country suited to Greek architecture. Our freestone, even the best of it, is badly qualified for long bearings, although, sustaining any degree of pressure, it be well suited to all sorts of arching, the characteristic of the Gothic style. [I make use of the nick-name, as that most familiar, till one more appropriate be generally adopted—"A rose, by any other name will smell as sweet."] The Greek system admits of only the Roman, the most clumsy of all arches. In the Greek, straight lines prevail, while the Gothic mode exhibits an infinite variety of curves, which are universally felt to be more gratifying to the taste than rectilinear figures. Those who admire the studied uniformity of Greek structures may still indulge that partiality; for although, in general, Gothic buildings are not so recurrently regular, yet the separate parts are doubtless as capable of being made

copies

copies of each other, as the Greek; and every member may be as highly ornamented—probably more so; for the Greek style precludes Gothic ornaments, and there are few of the ornaments of the Greek which may not be adopted in the Gothic. The grotesque carvings so frequent in this, may with advantage give place to sculptures in the Grecian taste, and not alter the nature of the Gothic style. And who but the most prejudiced would, in this climate, prefer a range of Greek columns, with their cumbrous entablature, to the airy elegance of a Gothic arcade? The one must be of a heavy, the other may be of a light appearance. In reality, buildings of the one kind require huge heaps of materials more than those of the other. And this circumstance, supposing equality in all else, becomes an important reason for deciding in favour of a Gothic style. This, owing its principal beauties to the arch, is so essentially dependant on the arch for its utility, and in truth the arch so characterizes its nature, that there seems not to be a more significant or distinguishing name for it than the *arched* style of building; the Greek style admitting the Roman arch only incidentally. Or, to avoid a confusion of sound and orthography, (though not of derivative meaning) suppose we denominate what has heretofore erroneously been called Gothic—*the Camarotan style of architecture*. [Καμαρωτὸς, *arched*.] The arches and the pillars are the main supports of the edifice, as the bones are of the animal frame. And, if by pillars and arches a skeleton be made according to the projected size and apartments of the intended structure, the interstices need be no more strongly built than is necessary to sustain their own weight. Compared with such, how excessive the quantity of materials in a Grecian fabric of like dimensions; which also requires individual stones of much greater

bulk

bulk and higher price, to the enormous augmentation of the estimates of the whole.

From the best specimens of Greek art have been deduced the rules of that prevailing system. But the Gothic mode, proving much more suitable to British purposes, it is of great moment that rules, drawn in the same way from its best specimens, should enable the nation to profit by the advantage, and bring it into general use.

By self-supporting arches, composed in regular curves semicircular, elliptical, or oval, with spans not more than a diameter for the first, and not longer than the shorter or conjugate diameters of the others, requiring no abutments, stone roofs may be constructed, covering any expanse, limited only by defects in foundation, materials or masonry—the foundation should be unshrinkable—the materials uncrushable—and the masonry unwarpable. Thus halls of the most spacious dimensions may be roofed: the arches, like the bones, constituting the strength and support of the body; the interstices may be made of slighter matter. Give the mammoth a firm footing, judiciously dispose his limbs and ribs, and put on him an impenetrable hide, and leave him for the multitudes who shall walk about under the canopy to look up and wonder at for ages to come. Suppose the main arches of freestone, the intervals of brick, and the whole paved and encrusted with basalt or granite. Such might serve for a hall of honour and of art, without the emblems of the one or the specimens of the other being buried, as in the vault-like aisles of St. Paul's, or huddled together as in the crowded cemetery of Westminster-abbey. Such a station is wanted for monuments of national glory, and for works of high art. Dedicate it, in the first instance, as a memorial of the battles of Trafalgar

falgar and Waterloo, and every accession of either kind would prove the utility of the structure, and at the same time attract notice to the original design of honouring the heroes Nelson and Wellington, and those who fought under their banners.

Where magnitude is principally attended to, taste imperiously demands simplicity of outline: the elliptical arch not only admits of this, but of such variety of proportions, as to afford opportunity of exercising the genius and judgment of every artist and critic in Europe. It is only by fit proportion that beauty can, in this case, be added to sublimity: but from the hemispherical dome to the pointed spire, through all the diversities of the cone, there is infinite occasion of choice. Less buildings are susceptible of minuter ornaments; and the ingenuity of Sir James Hall seems to have discovered the principle on which they are applicable. [See his *Essay on Gothic Architecture.*]

From the minor parts of many cathedrals, &c. one may readily conceive how commodiously the arched style may be adapted to mansion-houses and common dwellings as well as to larger public edifices. But there are wanting volumes of admeasurements of structures and of parts of structures, of acknowledged convenience and beauty, to guide the architect in his plans, and to direct the mason in his handy-work. From much and laborious and accurate research into how such things are, rules may be laid down how such things may be. A great deal too little has been done in this way; the generality having been deterred by the over-weening arrogance of Greek architects, who treated whatsoever was not conformable to their pre-conceived notions, with contempt and opprobrium.

The above observations are chiefly derived from what I con-

I consider a very valuable treatise on the subject, scattered in fragments through some volumes of Anderson's Recreations in Agriculture. [Sold by Cumming, 40, Holborn-hill, 8vo. 1800, 1801.] Dr. Anderson, the Editor, was most famed for his knowledge and writings in agriculture; and though the Recreations included variety of other matter, the books I apprehend fell into the hands of few but agriculturists, and the treatise alluded to has, I conjecture, obtained not much notice. I lately met with an architect of great repute who had never seen it.

I should not conclude without noticing that arched stone-roofed cottages have been built in Scotland; and found to answer well, especially where wood is scarce and dear. [See Sir John Sinclair's General Report of Scotland, 4 vols.—Appendix, 1 vol. p. 274, &c. 8vo. 1814.]

I am, Sir,

Yours, &c.

April 19, 1818. Wm. Taylor.

Description of a Piano Monitor.

By Mrs. M. A. WARREN, *of Glasgow.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted to Mrs. WARREN, *for this Communication.*

HAVING for many years practised music as a teacher, my inclination and duty have led me to try every improvement that presented itself within the scope of my imagination,

imagination, not only to inform my pupils of the principles which lead to the science of music, but also to form their habits so as to direct their practice to the attainment of its object: I need not, nor can I, perhaps, describe the methods pursued by different teachers with various success, whilst some have proved very prejudicial, and laid the foundation of errors fatal both to principle and execution.

To correct these errors (which generally arise from improper methods, or negligence when commencing with young beginners) has engaged a portion of my attention.

One of the greatest faults in execution I have had to combat was weakness in one or both wrists, occasioned often by inattention in the teacher, sometimes from stubbornness or indolence in the pupil; no matter from whom or whence the fault is derived, all the first teachers agree in considering it as fatal to the attaining any degree of perfection on the piano forte. To provide against the failing I have alluded to, and to assist both the teacher in conveying, and pupil in gaining, the necessary and elegant command of the instrument, I have attempted to construct an assistant for the wrist, which I have named the Piano Monitor.

With the greatest diffidence I present it to the Society of Arts for their inspection. The conviction I have of its utility, from the success with which I have applied it, gives me reason to hope it will in some degree be found worthy their attention. I must apologize for the want of mechanical knowledge it doubtless will exhibit, by urging that studies of this kind seldom form any part of female education. I have endeavoured to render it simple, so that a child can regulate it, which I conceive a very essential point to gain. Its construction, no doubt, can be much improved by those better versed in mechanics; yet, feeling

ing assured of its usefulness, I hope my humble exertions will be of service to those who teach, or learn music, on the piano forte.

The Application of the Piano Monitor.

Having before stated the errors which render the invention necessary as a remedy or preventive, I have only to add in what manner I have applied it to assist my pupils in conquering or avoiding the faults incidental to the wrists.

In using it with beginners I find it gives them a steady and even touch; it pitches their wrists to that height which enables them to execute with firmness, and by its having a spring, does not in the least deprive them of that expression and grace which an unmoveable rail would contract. I generally pitch it at that height which will allow them to play over it without touching the rail, except in striking an octave. Should they rest upon it, or attempt to strike the keys too harshly, the spring informs both teacher and pupil of the error, and by keeping the wrists in their position, saves trouble to the teacher, whose attention can be directed to other material explanations. The spring is more constant in its attendance than the teacher, being always present to assist their practice, when the absence of the teacher might occasion a relaxation of attention in this particular point.

Should a young hand be heavy or stubborn, the screws *m m*, Fig. 1, (Plate IV.) will fasten one or both ends, so that it will not recede from the pressure of the hand, and will oblige the wrists to keep their height; the Monitor is likewise of great use to those who, whilst advancing in theory, had been allowed in their practice to contract a weakness

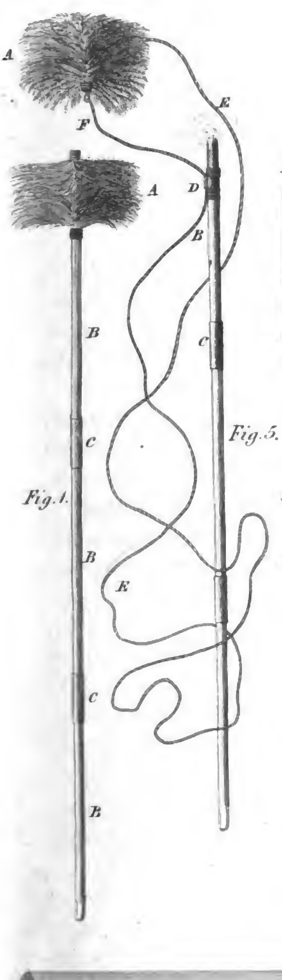


Fig. 1.

Fig. 5.

Fig. 6.

Fig. 7.

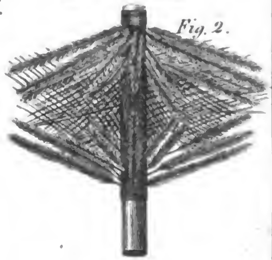


Fig. 2.

Fig. 8.

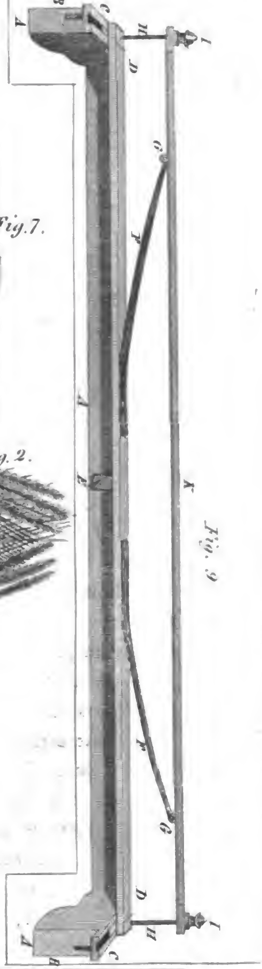


Fig. 9

Fig. 4.

Fig. 3.

weakness in their left wrist: for the monitor-rail can be fastened at the left side, whilst the other end is allowed to spring. The monitor-rail can be placed at any distance from the keys by the screw E, keeping the ends parallel to each other with the hand. I had two screws similar to E, one in each of the dove-tails C C; but the Monitor appeared too complicated, and I found that one answered the same purpose, and was much better calculated for juvenile comprehension. Other methods might be devised for fixing it on the instrument: I have made choice of that which I thought the most simple, as the holes for the pins are but small, and will not injure a piano forte.

The Monitor can be put on and taken off in an instant: I wish it to be particularly observed, it is not intended that the learner should always practise with the Monitor. The great advantage to be derived from its use, is the proper position of the wrists, which if once attained will not easily be lost, as the wrist being kept up, the sensitive part of the finger will touch the keys, when the Monitor is removed. The finger will necessarily touch the keys with the same part, consequently the wrist must take the same position without, as it was accustomed to with the Monitor.

Reference to the Engraving.

Fig. 9 (Plate IV.) represents the Monitor detached from the piano.

A A A, a frame of wood, which is fixed on the piano by means of the pins B B.

D D, a bar of wood, forming the base of the Monitor,

and traversing by means of two dove-tail pieces in the grooves C C.

E, a screw working in a collar, and passing through both A and D, in order to fix the Monitor at any convenient distance from the keys of the piano.

F F, two steel springs fastened by screws into the bar D, and terminated by small rollers G G.

H H, two brass pins terminated at their upper extremities as screws, on which the nuts I I work.

K, the rail of the Monitor terminated at each end by a brass ferrule, perforated so as to allow the rail to slide easily on the upright pins H H.

m m, Fig. 1, small screws, by which the rail may at pleasure be rendered motionless.

Description of a Machine for Sweeping Chimnies. By Mr. C. Wilson, *of Union Street, Borough.*

With an Engraving.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Ten Guineas were voted to Mr. Wilson *for this Communication.*

THE machine which I have recently invented for the purpose of sweeping chimnies has given complete satisfaction in all the cases in which it has been applied, and I hope will supersede the necessity of employing climbing boys.

Certificate.

Having purchased of Mr. Wilson, for 10*s.* 6*d.* his apparatus for sweeping chimnies, I put the same for trial into

into the hands of my people. We have now swept upwards of thirty chimnies with it in the neighbourhood of Blackfriars Road, to the satisfaction of our employers. The machine works so easy, that my son, twelve years old, finds no difficulty in managing it alone.

Dec. 2, 1816. (Signed) M. PALMER,
Chimney-sweeper, and Dealer in Soot.

REFERENCE TO THE ENGRAVING.

Fig. 1 (Plate IV.) the machine.

A, the brush, composed of quill feathers and stout slips of whalebone, fastened by means of a string round the end of a pole; the upper feathers and slips of whalebone pointing downwards, the lower ones upwards: as is more plainly seen in Fig. 2.

B B B, three lengths of pole fastened together by the joints C C, which latter consist of two wire hooks, fastened to the ends of the poles, Fig. 3, and covered by the ferrule, Fig. 4.

Fig. 5 is another form of the machine, in which the brush is moveable.

D, is a pulley fixed near the end of the topmost pole, and represented at large in Figs. 6 and 7.

E E, an endless cord, rove through the pulley, and fixed to the top of the brush, by the ring F, (shewn at large in Fig. 8,) and to the bottom of the brush by a hook.

On the adapting of Plants to the Soil, and not the Soil to the Plants. By *Mrs.* AGNES IBBETSON.

(Concluded from Page 55.)

I HAVE also known the same disorder seize trees, on being put into ground too rich for them. A friend of mine having just made a garden, which was not yet walled in, left a row of the *salix caprea* in a hedge to shade a walk. Being desirous of having very good vegetables, he manured the ground to the most excessive degree, *even to the edge of the trees.* In two or three years his trees began to decline, and at last got so bad, he consulted me what he should do with them. I advised the taking one for examination. I found most of the wood of the root decaying, while the side radicles were turned into putrid bulbs. We uncovered all the rest of the trees, and flung dry sand on them, mixing it with the earth that surrounded the roots: we saved all *but three.*

In tracing the various expenses necessary to a plant put out of its peculiar earth, I shall first mention *manure* as the most considerable. In proportion as the ground is adverse to the *plant,* so much more does the farmer load it with the only remedy he is acquainted with, "*dressing,*" to enable the plant to shoot. If the manure do not afford the juices it requires, and which its natural earth would *certainly* have *bestowed,* the *crop fails;* then the quantity of seeds must be more than doubled, which creates a second expense. Why are they obliged, in one county to put in so large a measure, and in the next half the quantity? Because not one seed in three takes effect, from not having those very juices dispensed to it its seeds seek, and the plant requires, to give it vigour and force

to

to grow. The ground is said to be full of seeds; *I believe it;* but the soil can only support such a number of plants; the seeds wait, therefore, till they can possess themselves of that *stimulus* wanted for their increase. Now dung happens to be composed of those ingredients necessary, of that salt and oil required by almost *every vegetable.* If, therefore, the soil be dressed with it, the seeds belonging to each peculiar ground shoot directly; and the sands send up *sand plants,* and the *chalk soil chalk plants,* and so on to the rest: for it is a great mistake to suppose that the embryo plant is concealed in the dung; indeed the vegetable, thus always appertaining to the soil, proves the contrary: but if the manure be not suitable, then that stimulus is still wanting, and the crop is *again said to fail.* How often does this happen; because some bad season makes the want of that peculiar juice doubly missed: then labour is a third expense, which must in excess belong to that plant which is placed in a wrong soil; for it will never be said that the vegetable that can grow spontaneously in that peculiar earth, can want any addition, besides the little manure, to increase its vigour, and render it more productive. All the labour, then, of dibbling, and throwing up the earth, might be saved in that case: indeed, this is a trouble that, I think, (if I might venture to say so,) might be saved in *many soils.* In clays, in chalks, or loams, it must be excellent, where a little motion of the earth round the roots of the plants, and an opening of the ground to admit the air, and dry the interior, must be most wanted, besides breaking the clods of earth; but in sand and gravel, that require no drying, or in a rich loam perfectly pulverised, it only deprives *that earth* of its little *moisture,* and moves the roots, where you would rather wish to render them more fixed and steady in the ground. And if it be on a hill,

a hill, where the soil falling down renders it thin, I have seen the practice kill many plants, by depriving them of the side thickness and moisture, which would otherwise compensate for the little depth of earth above.

I have now endeavoured to shew, that one of the principal parts of farming should be thoroughly to understand the soil of each field, and its sub-soil, and the *sort of plant* that suits that *peculiar ground,* that the farmer may be able to adapt them to the earth of which his estate consists; especially where, if he wants more variety, they are to be bought or exchanged with ease. The only desire of most cultivators is to make the farm answer in point of expense. This is all I mean by the plan I am suggesting,—"that that plant will yield a vast deal more in its own soil, and will repay for buying or exchanging that which would not grow without too much expense." How few are the plants that can possibly be wanted! ten or twelve at most: how easy, therefore, to suit these to his estate! A couple of different kinds of wheat for each soil; oats that agree well with it; and clovers that are naturalised to it. There are some plants that all farmers grow, but that nature seems to have made *as substitutes* to each other, for feeding of cattle; I mean turnips, carrots, parsnips, and cabbage: they each claim a different soil. The turnips do admirably in sand, the carrots in sand also, the cabbage in clayey ground, and the parsnips in good ground: as to potatoes, though preferring a *drained boggy earth* to all others, yet they are *so necessary,* they must grow where they can. But there is a terrible mistake in this country, in supposing they should be planted in dry ground; as the potatoes (I have proved, after sixteen years experience) will never be mealy, if not grown in tolerable *moist earth.* As to the others, one of them might be chosen as best suiting. It

is

is true, that a plant grows sick of the ground in which it is placed too frequently; because the peculiar juices are *exhausted*, which sustained and supported it. But a year's interim is sufficient to renew all, and restore the earth to its usual vigour; especially if a fallow *intervene*, of all the assistance the earth grains, the most *admirably advantageous;* for it is the manure of nature, if weeds are *not allowed* to grow on it: for *if they do*, they rob it of its richness, and burying them can make but poor amends, (by their crude and half-digested juices,) and can compensate but little for the support of a naked winter fallow.

That I should venture upon so daring a task, as to give hints to those very gentlemen who possess *such talents in agriculture*, so famous for their well-earned renown, seems a degree of presumption I must apologise for, as it shocks even myself: but from the first moment of my dissecting plants, I thought it must suggest ideas of this kind, and I have with care collected them. I may be said to arrive at the science by another road, one untried before, and of course having a different view of the subject. In dissecting, I could not but see that nature had formed the plant peculiarly for that individual soil, and to conform itself to its nature, *in every respect* suiting its defects, and possessing each its proper juices, in chemical affinity *with those* of the *soil*, but with that one only. Seeing this, may I not, with all humility, declare it, leaving to every one to draw their own conclusions? satisfied if one hint thrown out can be of service to those whose science enables them to judge so wisely of the matter. In this case I shall be happy in the undertaking, and think myself repaid for my labours.

I shall now give the clovers, and trefoils, &c. adapted to each soil; and should this letter be so fortunate as to

 please,

please, I shall in my next give the other plants equally suiting each earth.

Clay.

Trifolium minus, - - - - -	(Small Trefoil.)
Trifolium filiforme, - - - -	(Slender Trefoil.)
Medicago lupulina, - - -	(Black Medic, or Nonsuch.) *
Vicia sativa, - - - - -	(Common Vetch.)
Poa patensis, - - - - -	(Meadow Poa.)
Hog Peas.	
Cabbage.	
Anthoxanthum odoratum, -	(Sweet-scented Spring Grass.) †
Poa pratensis, - - - - -	(Meadow Poa.)
Dactylis glomerata, - - -	(Round-headed Cock's-foot.) ‡

Chalk.

Hedysarum onobrychis, - -	(Saintfoin.)
Trifolium procumbens, - -	(Hop Trefoil.)
Poterium, - - - - - -	(Burnet.)
Trifoliumo chroleachum, -	(Sulphur-coloured Trefoil.) §
Phleum Alpinum, - - - -	(Alpine Cats-tail.)
Trifolium scabrum, - - -	(Rough Trefoil.)
Anthyllis vulnararia. - - -	(Common Kidney Vetch)

Gravel.

Trifolium procumbens, -	(Hop Trefoil.)
Trifolium medium. - -	(Cow Grass.)

Sandy Soil.

Medicago sativa, - -	(Lucern.‖)
Trifolium pratense, -	(Perennial Clover.)
Trifolium officinale, - - -	(Melilot Trefoil.)

* I have seen this grow six years together, without any dressing, or a very trifling one.

† Excellent in clayey loams.

‡ Excellent for an early cutting. § On hills.

‖ A trial made in planting lucern in tolerably rich ground, and on poor sand, an equal quantity of manure to both. The first yielded of profit .... £ 6 4 4

The sand 11 5 6

Medicago

Medicago lupulina,	- - -	(Nonsuch.)
Lotus corniculatus,	- - -	(Common Bird's-foot Trefoil.)
Plantago lanceolata,	- - - -	(Rib-wort Plantain.)
Poa trivialis,	- - - - -	(Common rough-stalked Meadow-grass.*)
Thymus,	- - - -	(Wild Thyme.)

Loamy Soil.

Trifolium pratense,	- - -	(Perennial Clover.)
Trifolium repens,	- - - -	(White Dutch Clover.)

And many others.

Very Wet Soils.

Avena pratensis,	- - - -	(Meadow Oat Grass.)
Medicago falcata,	- - - -	(Yellow Medic.†)
Festuca fluitans,	- - - -	(Floating Fescue.)
Festuca elatior,	- - - -	(Tall Fescue Grass.)
Trifolium glomeratum,	- -	(Round-headed Trefoil.)

Grows very full, near wet ground.

Euphrasia officinalis,	- - -	(Officinal Eyebright.‡)

Very Dry Soils.

Trifolium albidum,	- - -	(White Siberian Melilot.)§
Anthyllis vulneraria,	- - -	(Common Kidney Vetch.)
Alchemilla vulgaris,	- - -	(Common Ladies' Mantle.)‖
Ajuga reptans,	- - - - -	(Common Bugle.)¶
Hedysarum,	- - - - -	(Saintfoin.)

* Though the cattle do not love the leaves, if the *least old*, yet they are very fond of the *seeds*, and they are very flourishing.

† Admirable in most soils.

‡ I saw a field covered with this, and one the festuca, and they yielded prodigiously.

§ Admirable in dry sand, if tolerably deep; will spread, as Miller says, without cultivation, if the sand be above a foot deep.

‖ Spreads excessively.

¶ Very cooling for cattle, and excellent summer food.

It is a great pity we do not try the *trifolium maritimum*, which all cattle like, and which, if the seeds are raked on the sand in salt marshes, will soon spread themselves all around.

This is but a poor collection; but I am trying each in its own soil, as carefully compounded as I can; and I hope, if the idea should strike as *just*, I shall be able, in most agricultural vegetables, to select sufficient for the farmer, as to save all laborious parts of the trial.

Let me not be supposed to say, that each plant will only grow in their original soil; they will most of them live, but they will often fail, get *disordered*, and *degenerate*. It is in this way that grass land grows accustomed to its soil, though adverse; but a year or two is not sufficient to reconcile the plant to the soil.

The first part of this letter was written more than a year preceding the present time. The trials I have since made have so completely confirmed the necessity of placing each plant in its own proper soil, that the matter will no longer bear a doubt by those who deeply study the subject; for each plant is not only formed by its leaves for the soil in which it was intended to exist, but in the root also; and of course the manner of taking in its nutriment is completely adapted for that soil. Thus, a sand plant takes the greatest part of its nutriment from the atmosphere; it is therefore loaded with hairs of various shapes and figures, which, receiving their juices from the dews, &c. prepare theirs according to chemical affinity, and then permit them (as soon as completed) to run from the hairs into the plant; while the roots (which are often thick and large, but which have very few *radicles)* are almost incapable of taking nourishment from the earth,

earth, and therefore the plant depends almost wholly on the exposure to the heavens; and it is on that account peculiarly necessary for these plants, that *aspect* should be most strictly attended to, and that they should be so placed as to face the east or south-east, receiving the morning and evening dew, and not too much exposed, and dried up the rest of the day. To these plants the soil or earth is of infinitely less consequence, than the aspect; and throwing away loads of manure is really expending money without cause or effect; since it will be of little use, except warming the ground, which assists most plants, but to do which only a small quantity of dung is necessary.

For clay plants, which take in less nourishment, from their leaves, indeed scarcely *one-fourth*, how different should be the provision the farmer makes for them. The root is formed with quantities of radicles, but all set close round: manure is here, therefore, of great use, if properly adapted; and labour, of still more. No ground costs so much as clay, which should *by rights* be considered in the lease; since to divide, pulverize, and dry, is the principal business of the farmer in clayey ground. Aspect signifies *nothing*, but a summer fallow will always be of admirable service. The root is loaded with radicles, but all close to the spreading part of the root; as the radicles of clay plants seldom like to run to a great distance, for fear of being cut off by the cracking of the clay.

The chalk plant takes much of its nutriment from the earth; this depends chiefly on soil; and adding sand to chalk is often as serviceable as manure; and the being well pulverized and mixed with the sand, is of no little consequence. Here again, therefore, much labour is required; nor is it of less use the ascertaining what sort of

chalk

chalk it is; some are infinitely more fitted for agriculture than others; some lime-stone or gypsum require only sand to make an admirable mixture; some absolutely require dung to be added to the sand to ameliorate the whole.

The water and semi-water plants require *water only,* as food; they take none from their leaves, but having their roots made for the purpose of inhaling water all day, and closing the pipes at night. These, of course, should be placed in very wet soils; and what a pity it is, we do not make use of the *festuca fluitans* in our swampy fields, when *too wet* for common pasture, and where it grows coarse and bad. Then once planting this grass, it would continue to come up each year: it is admirable for food; makes excellent bread, infinitely better than any thing I know, (except the finest wheat;) is good for gruel, and would grow in fields too wet for any corn or good grass. Horses are so fond of it they will half drown themselves to find it; it is particularly good in salt marshes, but grows well in fresh. The *festuca elatior,* which yields still more in fresh water fields, is admirable for grass, though it yields *no seeds:* it is indeed an hybride; but it gives a quantity of admirable grass, which horses will eat, and are extremely fond of; and a very early crop may be had, fit to be cut the end of April. The only disadvantage is, that it cannot be cut without dry weather; or the swampy ground is apt to hurt the men, and destroy much grass.

How necessary is all this knowledge to farmers! What a contrast is the mountain and rock plant! instead of taking its food from water, as in the last-named plants, it is wholly fed by its leaves; having no impervious skin, (which covers every other plant,) its open pores receive all the juices the atmosphere will bestow. They are so

formed,

formed, as to take no nutriment whatever from their roots, except what just suffices to form their seeds: the quantity they take in at their leaves is so great, that if the field is on a high mountain, and is well examined with a microscope, even at nono, the plants will almost always be found bathed in dew: many of the clovers, also, are mountain and rock plants, and take in all their nourishment at their leaves, and are constantly seen immersed in dew.

Of what use, then, is manure to such plants? It is throwing away money to expend it, when, in other parts of the farm, it might be so serviceable: would not this knowledge, so easily acquired, be of the utmost use to both farmer and gardener? So few are the agricultural plants, that rules for this purpose could be most easily given. But let me not be *misunderstood;* in very poor ground, it is necessary first to bring it from that *sick state* to a *better;* every ground requires some good manure; and this is particularly the case, when exhausted and neglected for many years. Then manuring is the best means to restore it to a healthy situation; and till it has got back to its usual state, it must be treated accordingly. For though sand plants take little from their root, yet that little is a rich part, and requires, therefore, *healthy juices;* which, when the ground is sick and poor, it cannot yield. All this will be made most plain, as well as enforce my first principle, by the detail of the manner of laying down very poor land for grass, which has lately been most admirably exemplified on an estate belonging to a friend of mine, bought for a song, and on which I persuaded him to try the experiment. It was supposed, no vegetable, corn, or grass, would grow in it; indeed, this was the first pleasing intelligence he received from his neighbours. Assured that the matter would succeed, from

from having repeatedly tried it, I pressed him to manage it in my way, treating his ground like a sick animal, and giving it plenty of wholesome nutritious food; but leaving to nature to bring up the proper grasses, nor counteract her in any way. At first, nothing was to be seen, but the poorest tribe of plants; *agrostis pallidor et canina* *, *festuca bromoides* †, tuft of the *galium uliginosum* ‡, and *galium aparine,* or goose grass. Hawkweeds, wild carrots, and all the sandy plants common to a very poor, light soil; for the soil was sand, with a bottom of yellow stiff clay. I then persuaded him to thoroughly plough the ground *very deep,* mixing the clay and sand very thoroughly together; and over the whole throwing a good dressing of dung. The next year, the *agrostis* had disappeared, the wild carrot also; the *sherardia* §, chamomile, and rib plantain, were discovered in their stead. *Bromus mollis, asperula odorata, agrostis littoralis* ‖, and *festuca duriuscula* ¶. The next year the land received a top-dressing of a little dung, but a good quantity of earth taken from a ditch, with lime. I examined the grass before it was cut, and with delight saw a quantity of cow grass or *trifolium pratense;* some excellent *bromi; festuca ovina,* in perfection, strong and thick; *medicago lupulina,* wild chamomile, rib plantain, &c. &c.; in short, some of the finest grasses a sand soil, in a high state of improvement, will give. Nor does it want any thing, to preserve it in its present state, but a top-dressing every other year. But this would not be sufficient to keep them in this high state of improvement, if they were not in their own soil: if it was a clay, or a gravel, it would be a totally different set of grasses that would come up, as

* Brown Bent. † Brome Fescue. ‡ Marsh Ladies' Bedstrew. § Field Madder. ‖ Sea side Bent. ¶ Hard Fescue.

I have

I have experienced. Some people insist, it is the dung *that brings* the seeds; but this *cannot be* the case, or they would not be always fitted to the soil.

A gentleman consulted me what he should do with his ground, plagued as he was with the *tussilago* *. He had ploughed the whole five times, without effect. I only advised him to dress it thoroughly with dung; and then, the next spring, throw on a fine quantity of sand, for the soil was limestone. In two years after, repeating this again, he had not a plant of the *tussilago* left, though, for five years before, he had been labouring against it without effect: the dung killed the poor plant. Thus, the two principles I wish to enforce in this letter are,—that the plant *should be suited to the soil,* if the farmer wishes to save himself the *expense* of making the soil suitable to the *plant*;—and secondly, that, in laying down grass, no plan is so good as that of continuing to manure, till the proper grasses (suitable to the soil, and fitted for that degree of cultivation) have established *themselves.* When this is once done, a very trifling assistance, every two or three years, will suffice to keep up the state of perfection in which the ground is placed; for when once the *good sorts* are *established, (in sand in particular,)* they require but *little manure.*

Of course, the example I have given can belong to grasses and clovers only, which are *natives;* but exotics require still more to be fitted for the soil in which they are placed; since it is better to have to struggle against climate only, than against climate and soil also.

* Coltsfoot.

Result of some Experiments in burning of Clay; in a Letter to the Society.

By the Rev. W. Wilkinson.

From the Letters and Papers of the Bath and West of England Society.

I HAVE been led to believe, that the result of some experiments I have had it in my power to make, in the burning of clay, and in the use of clay ashes as manure, may be acceptable to the Society.

At Lady-day, 1815, a tenant threw up a farm belonging to me at Woodbury, in Cambridgeshire; and I was induced, by many circumstances, to take it into my own occupation. The farm is of very considerable extent, and chiefly under the plough; the soil, a cold, stiff, tenacious clay; it had been overcropped for a long series of years, without a proportionate return of manure; and it is so situated, that no quantity of manure is to be purchased in the neighbourhood. It became my object, then, to raise as much manure as possible on the premises; and for this purpose I procured a north-country bailiff, who understands the management of turnips on a heavy soil; and having by accident seen Mr. Craig's letter on the burning of clay, I conceived mine to be a soil well suited to the practice. I accordingly, after some correspondence with that gentleman on the subject, made my first experiment in the end of September, 1815. I deviated a little from the plan laid down in Mr. Craig's printed letter. Having marked out a space of 15 feet by 12, I excavated it one foot deep, and with the soil thrown out made a wall around the space. At each corner I made an air-pipe, each pipe (made of sods) extending only two feet into the enclosure, in a diagonal direction. In the

centre

centre of the enclosure I placed upright the but end of a large tree, around which other fuel was placed, covering the bottom of the whole space within the wall. The fuel consisted of straw, bushes, large billets of wood, and dry roots of trees. I then put dry turf over the whole surface, which again was covered with a thin coat of clay, newly dug up, except a small hole by which the fire was introduced. The fuel being dry, the fire spread rapidly, and it required the active exertions of two men to smother the flames as they burst out; they used for this purpose dry turf, which they immediately covered with clay. During the first two or three days the surface of the heap occasionally sunk in places, and apparently grew cold; into these places fresh fuel was put, care being taken to make but small openings; and I may here remark, that this operation should be done as speedily as possible; for external air let into the heap, after it was once fairly on fire, seems to do mischief.

It now burned well, and evenly over the whole surface, for several days; each covering of clay crumbling to ashes in an hour or two after it was put on. It appeared to burn quicker or slower, according to the state of the atmosphere. In about a week's time from the commencement of the experiment, the heap grew to such a height, that a difficulty arose in lodging the fresh clay on the top of it, although the walls had been heightened; and I attempted, as recommended by Mr. Craig, to pull down one of the side walls, and enlarge the base by spreading the hot ashes. In this attempt I did not succeed without much trouble; and I was obliged to add a great quantity of fresh fuel, before I could accomplish my object, and restore the heap to its former heat. It continued to burn well four or five days after this operation; but, as the days were becoming short, I did not

O 2 attempt

attempt to spread the base still further, but permitted it to burn out.

This heap was on fire twelve days, and was constantly attended in its progress by two men, from four o'clock in the morning till nine at night; when a thicker coat of clay than usual was put on: one of these men was chiefly employed in digging the clay, the other in wheeling it (only a few yards) to the heap, and throwing it on, sometimes by hand, and sometimes with a spade. This heap I afterwards found contained 37 cart-loads of ashes; and as my farm lies nearly level, and it was removed to no great distance, the carts were well filled; each load, probably, consisted of a cubic yard of ashes.

In the spring of this year, 1816, I burned another heap, which was found to contain upwards of 40 loads of ashes; and during the summer I burned two more heaps, the one contained 72 loads of ashes, the other about 55 loads.

I will not take up your time in describing the progress of these heaps so accurately as I have done that of the first. In fact, the operation proceeded in all the cases precisely in the same manner. I remarked, however, latterly, that the labourer who conducted this business for me became more expert, especially in spreading the base of the heap; though, even at last, this was not done without a considerable expenditure of fuel. I never had more than two men and a boy employed at once; and my bailiff having kept an exact account of the expense attending these experiments, I am enabled to state, that, on the average, the cost was about 1s. 6d. the cart-load. In this calculation nothing is charged for the fuel, having plenty of bushes and offal wood on the premises; a value, however, was put upon it as it was used, and 3d. or 4d. per load may be added on this account;

count; I may therefore say, that the whole cost was 1s. 9d. the cart-load.

I will now add a few general remarks, which may be useful to any one who may wish to burn subsoil. The fire appears to spread upwards most readily, and the heap grows first cold at the bottom, and towards the walls, for I seldom remarked that the fire penetrated through the walls. As my experiments were made in different parts of the farm, there was a slight variation in the soil; and I observed, that, where the clay had no mixture of gravel or stones in it, it burned the best; and I always thought it crumbled quicker, when it was put on newly dug up. Summer is certainly the best season for this operation, chiefly on account of the short nights, which permit the heaps to be watched with more ease. Moderate rain does but little harm to the fire; high winds are infinitely more destructive to it. I do not think the clay loses much in quantity by being exposed to the action of fire; but it certainly decreases in weight. Wood is supposed to be the best kind of fuel, coal requiring too much air to promote combustion.

It now remains for me to give what information I am able, in regard to the beneficial effects of clay ashes as a manure. The heap of ashes I burned in the autumn of 1815, was used early in this year to manure an acre and a half of land, part of a much larger field. A part of the same field had been folded late in last year with sheep, and the remainder was manured with very good yard dung. The whole field was cropped with barley; and either from the seed being ploughed in too deep, or some other cause, the crop was not a very good one; but I may truly say, that the part manured with ashes was better than that dunged: the part folded was evidently the worst. The same gradation may now be observed in the

clover

clover plants, the seed of which was sown soon after the barley.

The greater part of the heap of ashes I burned this spring was used in the beginning of June to manure an acre and a quarter of land, in the middle of a field of five acres, the remainder of which was manured with the best yard dung. The whole was sown towards the middle of that month with red-rind turnip seed; a Northumberland drill was employed to deposit the seed; the distance between the ridges being two feet and a half, so as to admit the horse hoe. The crop is a very good one indeed, many of the turnips being 26 inches in circumference; and one, which I had taken up and weighed, was 29 inches in circumference, and weighed 11½ lbs. I do not perceive that the part manured with clay ashes has at all an inferior crop on it to the rest of the field; my bailiff, indeed, remarked, that on the plants first coming up, he thought them there the best.

From this heap of ashes six loads had been reserved, which were thrown, the end of June, over somewhat less than a quarter of an acre of rough grass land; and it is perceptible, that the sheep, during the summer, have eaten that part of the field more closely than the rest of it.

The two heaps of ashes I burned during the summer, containing together near 130 loads, have been used, this last October, to dress six acres of land, which had been got into a good tilth by a naked fallow; the ashes were first spread, the wheat seed was then sown, and they were lightly ploughed in together. The rest of the field, in which these six acres lie, had been folded with sheep on a naked fallow, and was sown with wheat about the same time. I left my farm about ten days ago, when the young wheat was just come up; and it appeared full

as

as thick on that part of the field manured with the ashes, as on the remainder of it.

I have thus, in the course of a year, burned upwards of 200 loads of ashes, and manured nine acres of land, at an expense, fuel included, of about £.18; and I am so well pleased with the result of these experiments, that it is my fixed intention to burn ashes, to a much greater extent, during the next year.

Having brought my communication to a close, I may be permitted to say, that the practice of burning subsoil is not altogether novel; Lord Halifax, and others, pursued it in the beginning of the last century; and successful experiments of the same nature have been made from time to time, until Mr. Craig, of late years, has introduced the practice into the south-western parts of Scotland. It is now to be hoped, that, being better understood, it will become more general. I take the liberty, however, of recommending to those gentlemen who feel inclined to burn subsoil, to consider, first, the fitness of their soil for the purpose; and whether or not their situation affords a facility of procuring other well-known manures; for, as this practice is not unattended with expense, it must always be a matter of calculation, whether other manures cannot be procured cheaper.

I would, lastly, recommend to them, if they do make the trial, not to be content with a single, desultory experiment, which, from many causes, may possibly fail. My own success, in the first instance, I attribute, in some measure, to having a plentiful supply of dry fuel on the spot; but chiefly to the repeated instructions of Mr. Craig, to whom I thus publicly make my grateful acknowledgments.

I do not think the practice likely to spread among *tenants* of farms; few tenants will go to the expense of pur-

purchasing fuel; and few landlords will allow them to cut it for this purpose on their farms; besides, the digging the soil disfigures the spot where it takes place, and few tenants will take the trouble to make it neat again.

The Marquis of RIDOLFI's *Method of separating Platina from the other metallic Substances which are found with it in the State of Ore; from the "Giornale di Scienze ed Arti," published at Florence.*

Extracted from the JOURNAL of SCIENCE and the ARTS. Edited at the ROYAL INSTITUTION.

THE Marquis Ridolfi, after giving a detail of various experiments which he has made upon platina, proceeds thus: "No one has been able to combine sulphur with platina, so as to form a sulphuret of that metal. From this peculiarity of platina, the idea struck me that if one could convert the other metallic substances found in platina into sulphurets, it would be easy to purify that metal. With this view, I took an ounce of crude platina, and separated from it some of the extraneous substances usually mixed with it. I washed it with nitro-muriatic acid, diluted with four times its weight of water. I then washed it in hot water, with a view of removing portions of iron and of gold which might be in the powder; but I afterwards found these washings useless. I then melted the mass with half its weight of pure lead, and threw it into cold water, and thus obtained an alloy which was pulverised and mixed with an equal portion of sulphur. I threw the mixture into a white-hot Hessian crucible, which was instantly covered, and let it remain in an intense heat for ten minutes. I then suffered it to cool gradually. It contained much dross, and a brittle metallic

tallic button composed of platina, lead, and sulphur. I then again fused it with a small addition of lead, and when it had cooled I found that the sulphur was in the dross, and that there only remained an alloy of platina and lead.

I then heated this alloy to whiteness, and beat it with a hot hammer on a hot anvil, which forced out the lead in fusion. Here I must observe that unless the alloy is white hot the beating must be suspended, as it will break.

I thus obtained platina so pure as to make with it a capsule, a spoon, wire, and leaves which were nearly as thin as gold leaf. It was ductile, malleable, and as tenacious as that obtained from the ammoniacal muriate. Its specific gravity was 22,630.

This description is sufficient to shew the purity of the platina. I repeated the process several times. I did not always find the platina in a lump at the bottom of the crucible, it was sometimes scattered in globules amongst the dross. In this case it is only necessary to heat the mass with a little diluted sulphuric acid, the globules are soon liberated from the dross, and sink to the bottom of the crucible. Collect and wash them, and submit them to the same operation of the hammer, as if the platina had been found united in one mass with the lead. I did not ascertain whether all the metals contained in the ore had become sulphurets, but they were all separated from the platina during the fusion and the formation of the sulphuret of lead.

On the native caustic Lime of Tuscany; by the Marquis Ridolfi.

The interesting communication of Dr. Giovacchino Taddei respecting his discovery of caustic lime in the water

water of the ancient bath of Santa Gonda, in August, 1815, induced me to visit the spot. The following is the result of my researches:

The bath is situated in a laguna in the corner of a field near the high road to Pisa, which divides the plain called la Catena, from the mountains of Cigoli and San Miniato. The soil is a mixture of clay, calcareous earth, siliceous sand, and vegetable matter. There are two sources of water, one issues from the bottom of the laguna, and the other from the side. The first is hot, raising the thermometer of Reaumur to 35¼. It is so saturated with lime, that upon cooling the water, it deposits a considerable quantity. It contains also muriate of lime, and muriate of soda. The upper spring contains a little carbonic acid gas, some sulphuretted hydrogen, and some sulphate of soda. The following is the manner in which the caustic lime is formed in this bath. The lower spring yields a quantity of lime, but as this spring does not rise freely, but oozes through the bottom of the bath, the lime forms a stratum at the bottom of the laguna; which stratum absorbing the carbonic acid gas of the water above, passes to the state of a carbonate, and thus forms a defence to the lime, which is continually depositing itself underneath, and prevents it losing its causticity. In fact, the caustic lime is found inclosed between the stratum of the carbonate of lime and the clayey bottom of the laguna.

Signor Taddei found the masses of caustic lime so large, that he could not get them out but by breaking them into pieces. He, however, succeeded in removing the whole of it: and I, having visited the spot two months after, found small incrustations of the same substance newly formed.

Analysis

Analysis of the native caustic Lime. By Mr. Faraday, *Assistant in the Laboratory of the Royal Institution.*

This substance came to England in a bottle filled up with water, the atmospherical air being perfectly excluded.

It is almost entirely soluble in muriatic acid without effervescence, leaving nothing but a few light flocculi. The solution, when tested, was found to contain lime and iron.

A clean uniform piece of the substance was dried, as much as could be, by bibulous paper. A fragment of it being heated red, lost 62.26 per cent. of water.

The remainder, weighing 188 grains, was dissolved in muriatic acid, and evaporated at a high heat on the sand bath, acid was again added, and the evaporation repeated. Water was poured on it, and the silica separated: when well washed, dried, and heated red, it weighed 7.5 grains.

The filtered solution was precipitated by carbonate of potash, and the precipitate boiled in solution of pure potash. The solution was separated from the solid matter, neutralised by sulphuric acid, and precipitated by carbonate of ammonia. The precipitate, when well washed and dried, weighed 95 grains. It was soluble in sulphuric acid, and possessed the properties of alumina.

Diluted sulphuric acid was added to the solid matter, not acted upon by the potash: the whole boiled for some time, and then filtered. The sulphate of lime obtained weighed, after being heated red, 136 grains, which, estimating the lime at 43 per cent., is equivalent to 58.48 grains of lime.

The sulphuric solution was precipitated by ammonia, and two grains of oxyd of iron were obtained.

 Sup-

Supposing the quantity of water in every part of the piece first taken to be uniform, it would follow that the 188 grains contained 117.05 of water; so that 70.95 was the quantity of dry matter acted upon. The results were

	Grains.
Silica - -	7.5
Alumina -	95
Lime -	58.48
Oxyd of iron -	2
	68.93

The loss is therefore rather more than two grains, which may, perhaps, actually have taken place, and the difference may have been derived from the unequal diffusion of water throughout the piece.

Supposing 100 parts of the specimen to have been taken, the analysis will stand thus:

	Grains.
Lime - -	82.424
Silex - -	10.57
Iron - -	2.82
Alumina -	1.34
Loss - -	2.846
	100.000

It is, perhaps, worthy of observation, that during the solution of the substance in muriatic acid, a part only of the silica separated; the greater part remained in solution until heat was applied, when it gelatinised, as in the case where it is separated by an acid and heat from its combination with alkali.

Observations

Observations on the preceding Paper. By Sir H. Davy, *V. P. R. I. F. R. S.*

The Duchess of Montrose was so good as to send me the caustic lime which is the subject of the preceding analysis; her Grace received it immediately from Tuscany. It was in a bottle, carefully sealed and full of water. Some of the exterior portions had become combined with carbonic acid before they were collected, and from the colour, it appeared that there were different portions of protoxyd of iron in different parts of the substance.

On examining the water, it was found to be a saturated solution of lime, and it contained fixed alkali, but in quantities so minute, that after the lime was separated, it could be made evident only by coloured tests.

It appears from Mr. Faraday's analysis, that the menstruum which deposits the solid substance must be a solution of silica in lime-water; and heat is evidently the agent by which the large quantity of lime deposited is made soluble, and is enabled to act on silica; and the fact offers a new point of analogy between the alkalies and the alkaline earths.

Vestiges of extinct volcanoes exist in all the low countries on the western side of the Appenines; and the number of warm springs in the Tuscan, Roman, and Neapolitan states, prove that a source of subterraneous heat is still in activity beneath a great part of the surface in these districts.

Carbonic acid is disengaged in considerable quantities in several of the springs at the foot of the Appenines; and some of the waters that deposit calcareous matter, are saturated solutions of this substance. Calcareous tufas of recent formation are to be found in every part of

Italy.

Italy. The well known Travertine marble, Marmor Tiburtinum, is a production of this kind; and the Lago di Solfaterra near Tivoli, of which I shall give a particular account on a future occasion, annually deposits masses of this stone of several inches in thickness.

It is scarcely possible to avoid the conclusion that the carbonic acid, which by its geological agency has so modified the surface of Italy, is disengaged, in consequence of the action of volcanic fires on the lime-stone, of which the Appenines are principally composed, and liberated at their feet, where the pressure is comparatively small; but the Tuscan laguna offers the only instance in which the action of these fires extends, or has extended, to the surface at which the water collected in the mountains finds its way to the sea, so as to enable it to dissolve caustic calcareous matter.

On Saline Crystallization. By ANDREW URE, *M. D. Professor of the Glasgow Institution, and Member of the Geological Society.*

From the JOURNAL of SCIENCE and the ARTS, Edited at the ROYAL INSTITUTION.

IT is well known that water and solutions of some salts will, under certain circumstances, preserve their fluidity, though cooled down many degrees below their ordinary congealing or crystallizing temperature. The most convenient, and perhaps striking mode of exhibiting this phenomenon, is to fill a phial with a hot saturated solution of sulphate of soda, to cork it well, and set it to cool in a quiet place. When the cork is afterwards withdrawn, the liquid stratum at the surface instantly becomes a solid, with a pearly lustre; then the parts beneath

neath successively assume the same form, and thus the whole solution in a few seconds changes into a confused crystalline mass. At the instant of solidification the temperature arises from 30 to 40 degrees, affording a fine illustration of the doctrine of latent heat. Should the mere extraction of the cork fail to occasion this curious transition from the liquid to the solid state, it will be infallibly produced by touching the surface of the solution with a crystal of the salt.

This phenomenon has been ascribed by some, to the sudden abstraction of a portion of heat from the liquid, on the admission of the external air; whence the crystallization is determined at the surface, and proceeds gradually downwards; other hypotheses have also been offered; but I am not aware of any experiments having been made, with the view of elucidating the connection of this phenomenon with the atmospheric air and other causes. The following, which were executed about two years ago, may perhaps serve to open some new trains of investigation.

1st. An 8 oz. phial filled with a saturated solution of sulphate of soda in boiling water was cooled down to 38° Fahr., (the temperature of the apartment,) without crystallizing, the mouth of it being well secured with ox-bladder, which the pressure of the atmosphere had deeply hollowed on the contraction of the liquid volume by cold. The phial was placed under the receiver of an air-pump. When the quicksilver in the two legs of the syphon gauge stood nearly on a level, the bladder became convex, though it had been strained flat across the orifice when the phial was brimful of the boiling hot solution. On piercing the bladder with a sharp pointed rod, which passed air-tight through a collar of leathers in the top plate of the receiver, no change whatever took place; the

the point was then pushed down into the liquid without any further effect. To try the influence of vibratory agitation of the particles, the handle of the air-pump was briskly moved backwards and forwards; when immediately a portion of the solution was thrown out of the phial with an explosive effort upon the receiver. The liquid instantly shot into a confused crystallization, and at the same time began to boil, from the heat evolved during solidification. The temperature of the saline matter in the phial, when it was withdrawn at the end of a few minutes, was still 74°, though it must have lost much heat from the ebullition *in vacuo*.

2. The same experiment was tried a second time; and though no effect took place on piercing the bladder, yet on afterwards passing down the steel point into the liquid, crystallization, with the usual pearly appearance, commenced at the surface, and descended to the bottom. I believe that in this case the steel point at its first descent to puncture the bladder had touched the liquid, and thus became tipped with a little saline matter, which drying rapidly *in vacuo*, served at the second plunge as a nucleus of crystallization.

3d. The bladder was freely punctured *in vacuo* without effect; the air was slowly admitted into the receiver till it was of the atmospheric density. No change ensued at the end of two hours. The receiver was withdrawn, and the punctured hole enlarged by scissars without any result. But on slightly shaking the phial, the liquid passed speedily into the solid state.

4th. The sulphate was again liquified in the same phial, which was now closed with a perforated cork. Into this was fitted a glass tube $\frac{1}{10}$ inch internal diameter, and 4 inches long. As the tube passed only half way down through the cork, no liquid could enter it. After standing

standing for fourteen hours exposed to the action of the external air*, through the tube, its liquidity was unimpaired. The glass tube was then withdrawn, and next the cork, without any change ensuing; when finally, on agitation, it solidified.

5th. A phial was nearly filled with a similar solution of sulphate, on the surface of which was placed a little olive oil. It cooled without crystallizing. When smartly agitated, it became solid, with the usual phenomenon of the crystals shooting from the top downwards. This phial had been first placed on a vibrating glass plate, without effect. This experiment was repeated with a like result, though the phial stood two days.

6th. A corked phial full of the hot solution was tied down to the plate of the air-pump, so that the cork could be drawn *in vacuo* by a sliding steel rod and hooked extremity. When the cork was pulled, no change ensued; but agitation congealed the mass.

7th. The corked phial was cooled in a horizontal position; on inverting it quickly, the liquid struck against the glass, as in the water hammer. By brisk agitation in the inverted position, congelation began, first below, and ascended to the top of the liquid. This experiment was repeated, with the same result. No particle of air was left in the phial; a cork of the best quality being pressed on the surface of the liquid, and forced in as the liquid contracted its volume, on immersing the phial into a basin of cool water.

8th. A glass tube twelve inches long, and one inch in diameter, furnished with a brass cap and stop cock at one end, and a tight cork at the other, was filled with the

* Temperature of the apartment about 40° Fahr.

hot solution. When it was cold, each end was opened, and the crystallization began instantly at the two extremities, and proceeded to the middle.

9th. Same tube filled and cooled, with a platina wire passing through the cork. On applying to each end, the opposite electric influences of a voltaic battery of 50 pairs of 4-inch plates, the pearly crystallization commenced at the negative end, and proceeded slowly to the positive, at which no symptom of spontaneous congelation could be perceived. The platina wire was positive, and evolved oxygen pretty copiously.

10th. A large egg-shaped vessel, holding about two pints, and terminated at each end with cylindrical apertures of one inch diameter, was filled with the hot saturated solution. Through the cork of each end was passed a platina wire. The vessel, after having been cooled in a bason of cold water to the temperature of 42°, was placed in a horizontal position, and the solution was subjected to the action of a battery of 60 pairs of 4-inch plates. From the oppositely electrified wires, hydrogen and oxygen gases were copiously evolved. The quantity of gas was much more abundant than I ever observed it from pure water with the same voltaic power. Hence, a saline solution affords a better medium for the popular exhibition of this fundamental electro-chemical fact, than water alone. After a few seconds, the pearly lustre appeared at the negative end of the vessel, and the crystallization proceeded slowly and steadily towards the positive end, the plane of demarcation between the congealing and liquid part being perfectly smooth and vertical. No tendency to solidification was observed at the positive end, though gas freely flowed from its platina wire during the whole time that the process of crystalli-

zation

zation was advancing from the one extremity to the other. This interval was about 15 seconds.

10th. The above experiment was repeated with a small cylinder with tubular extremities. The negative wire projected internally only to one half the length of the positive wire, in order to see whether it was merely the greater quantity of hydrogen evolved, or some difference in the electrical properties that determined the crystallization at the negative pole. Here again, as before, the pearly appearance commenced at the negative extremity, and proceeded beautifully to the positive.

It was impossible now to doubt, that there existed some relation between negative or resinous electricity, and saline crystallization.

11th. Two glass capsules were then taken. Into each an equal quantity of a tepid solution of pure nitre was put. They were placed along side of each other, and the liquids were connected by a slip of clean filtering paper, moistened with pure water. The power of 60 pairs in moderate action was applied, through the medium of a platina wire dipped into the centre of each solution. In a short time small needles were seen collecting, and attaching themselves around the negative platina wire, which soon increased so as to float through the whole liquid. After a much greater interval a few crystals were perceived forming on the margin of the liquid in the positively electrified capsule, but none near the immersed platina wire. In equal times the quantity of crystals in the negative capsule was quadruple of that in the positive capsule. There was found in the former a very slight excess of alkali, and in the latter of acid, but such as in ordinary circumstances has no influence on the formation of crystals.

12th. A tin flask was filled with the same hot solution,

and having its mouth secured with a slip of ox-bladder, it was suffered to cool. It was then placed on the top of a delicate condensing electroscope; and the bladder being pierced with a needle insulated at the end of a glass rod, no divergence of the gold leaves could be observed, even when both the large and small condensing plates had been folded back. I am not certain that in this case the liquid had remained uncrystallized till the instant of piercing the bladder. I shall repeat and vary the experiment, and from the elevation of temperature accompanying the solidification, I shall be able to ascertain whether the experiment has been successfully conducted, and whether any general inference can be drawn from it.

I think it probable from the above detail, that negative electricity may be found a useful agent in promoting the crystallization of saline matter, and may perhaps be employed by Nature in her crystalline formations.

The effect of mechanical disturbance in determining saline crystallization, is illustrated by the symmetrical disposition of particles of dust and iron by electricity and magnetism. Strew these upon a plane, and present magnetic and electric forces at a certain distance from it; no effect will be produced. Communicate to the plane a vibratory movement; the particles at the instant of being liberated from the friction of the surface, will arrange themselves according to the laws of their respective magnetic or electric attractions. The water of solution, in counteracting solidity, not only removes the particles to distances beyond the sphere of mutual attraction, but probably also inverts their attracting poles. Hence, when they are again brought within the attracting limit, by abstracting the water or the repulsive caloric, some additional force is necessary to revert this liquid arrangement

arrangement of the poles. It is thus that a crystal, brought into contact with the surface of the solution, may be conceived to act.

Experiments 3d, 4th, and 5th, seem to prove that neither the chemical properties of the atmosphere, nor its pressure, have any influence on the crystallization.

On the Analogies between the undecompounded Substances, and on the Constitution of Acids.

By Sir HUMPHRY DAVY, *LL.D. V.P.R.I. F.R.S.*

Extracted from the JOURNAL of SCIENCE and the ARTS. Edited at the ROYAL INSTITUTION.

IN a work, published in 1812*, I have pointed out some of the analogies between the substances, considered in the present state of our knowledge, as undecompounded, and I have endeavoured to found a classification upon these analogies.

I placed oxygen and chlorine together, because, in combining with inflammable bodies and metals, they produce heat and light in a much higher degree than any other known species of matter, and because many of their compounds are possessed of analogous, chemical, and electrical qualities. At the same time I stated, that there is a general chain of resemblance between all the chemical agents, and that while sulphur is analogous to chlorine in one of its properties, it possesses more general resemblances to phosphorus.

The progress of chemical discovery since that time has added new links in the system of analogy, and modified some of the ancient links. The singular body iodine,

* Elements of Chemical Philosophy.

whilst

whilst it strongly resembles chlorine in most of its chemical qualities, is still more analogous than chlorine to sulphur; and in lustre, opacity, specific gravity, and the high proportional quantity in which it unites to other matter, it is similar to the metals. With the metals, indeed, it may be said to be distinctly connected by means of tellurium, which, as I have shewn, by uniting to hydrogen, forms a substance having acid properties.

Carbon, boron, and silicon, appear the links between phosphorus and sulphur and the metals, and probably the basis of zircona, glucina, and alumina, will form a part of the chain between the metals of the alkaline earths and the common metals.

Hydrogen and azote stand almost alone; yet hydrogen is connected with the common inflammable bodies by the manner in which it combines with oxygen and chlorine, and azote resembles carbon in the proportional quantity in which it enters into combination, and in its want of attraction for metallic substances. Fluorine, probably, if it could be obtained insulated, would form the link between oxygen and chlorine and azote.

M. Gay Lussac, in an elaborate paper published in the Annales de Chimie for July 1814 *, in which he has

* The historical notes attached to that paper are of a nature not to be passed over without animadversions. M. Gay Lussac states in these notes, that he and M. Thenard first advanced the hypothesis, that chlorine was a simple body, and that he was the first person to demonstrate the nature of iodine; and he quotes M. Ampere as having had before me the opinion that chlorine and fluorine were simple bodies. On the subject of the originality of the idea of chlorine being an elementary body, I have always vindicated the claims of Scheele, but I must assume for myself the labour of having demonstrated its properties and combinations, and of having explained the chemical phenomena it produces; and I am in possession of a letter

has advanced many views, reasonings, and calculations, upon the composition of the compounds of chlorine, exactly the same as those I have given in the these papers published three years before in the Transactions of the Royal Society *, endeavours to shew that there is a stronger analogy between chlorine, iodine, and sulphur, than between the same bodies and oxygen; and he wishes them to be separated as a class from oxygen, and placed in a class with sulphur. I do not admit the force of his reasoning on this subject; the bodies to which he refers have only one marked point of resemblance to sulphur, that which I have mentioned above, and they differ from it in their electrical relations, and in the chemical and electrical nature of all their other compounds, and agree in these respects with oxygen. Like oxygen in voltaic

a letter from M. Ampere, which shews that he has no claim of this kind to make.

With respect to the nature of fluoric acid, still a hypothetical subject, M. Ampere was certainly *original*; but he formed his opinion in consequence of my views of chlorine; and I had imagined and applied the hypothesis before I had any communication from M. Ampere, and in my paper on the subject I have done all the justice that was in my power to the views of that ingenious academician.

With regard to iodine, the first account I had of it was from M. Ampere, who, before I had seen the substance, supposed that it might contain a new supporter of a combustion. Who had most share in developing the chemical history of that body, must be determined by a review of the papers that have been published upon it, and an examination of their respective dates. When M. Clement shewed iodine to me, he believed that the hydroiodic acid was muriatic acid; and M. Gay Lussac, after his early experiments made originally with M. Clement, formed the same opinion, and *maintained it*, when I *first* stated to him my belief that it was a new and peculiar acid, and that iodine was a substance analogous in its chemical relations to chlorine.

* Philosophical Transactions, 1810, 1811.

arrangements,

arrangements, they are determined to the positive surface, whereas sulphur is separated at the negative surface; the compounds they form with metals strongly resemble those formed by oxygen; they are electric, and many of them soluble in water and possessed of acid properties; whereas those formed by sulphur are all nonelectrics and insoluble.

I cannot admit M. Gay Lussac's views on the classification of the undecomposed substances, nor can I adopt his ideas respecting their properties as chemical agents. He considers hydrogen as an *alkalising* principle, and azote as an *acidifying* principle. This is an attempt to introduce into chemistry a doctrine of occult qualities, and to refer to some mysterious and inexplicable energy what must depend upon a peculiar corpuscular arrangement. If hydrogen be an alkalising principle, it is strange that it should form some of the strongest acids by uniting to bodies not in themselves acid; and if azote be an acidifying principle, it is equally strange that it should form nearly nine-tenths of the weight of the volatile alkali. It is impossible to infer what will be the qualities of a compound from the qualities of its constituents; and if M. Gay Lussac's views were correct, the prussic basis of azote and carbon ought to have its acid properties diminished, and not increased, as he has proved them to be, by combination with hydrogen.

When certain properties are found belonging to a compound, we have no right to attribute these properties to any of its elements to the exclusion of the rest, but they must be regarded as a result of combination.

When M. Gay Lussac assumes that oxygen and hydrogen, in the proportions in which they form water, are passive as elements of a combination, it is a *pure assumption,*

tion, and opposed to the whole series of chemical facts. Hydrogen with chlorine forms a strong acid; oxygen with phosphorus forms a strong acid; and supposing water combined with the compound of phosphorus and chlorine, the results contain two of the energetic known acids: phosphorane does not redden litmus paper, but if it be dissolved in water it becomes a solution of muriatic and phosphorus acids.

If oxygen and hydrogen, in the proportion in which they form water, are to be considered as passive, as neutralizing each other in all combinations in which they exist, then almost all the vegetable acids must be considered as acids of carbon, which, though containing much less oxygen than carbonic acid, and some of them less even than carbonic oxyd, have yet strong acid powers.

I have discovered a gaseous combination of four proportions of oxygen and one of chlorine, which has no acid properties. M. Gay Lussac has discovered a compound of two proportions of hydrogen, one of chlorine, and six of oxygen, which has acid properties; but he considers this substance merely as chlorine acidified by oxygen, and neglects the hydrogen, without which he allows, however, it cannot exist. He supposes that this acid of one proportion of chlorine and five of oxygen exists in all the hyper-oxymuriates, but he does not support his supposition by any proof. The hyper-oxymuriates are, as I shewed six years ago, composed of one proportion of chlorine, one of a basis, and six of oxygen. Hydrogen, in M. Gay Lussac's chloric acid, may be considered as acting the part of a base; and it is an important circumstance in the law of definite proportions, that when one metallic or inflammable basis combines with

certain proportions of a compound, all the others combine with the same proportions.

M. Gay Lussac states, that if the chloric acid be not admitted as a pure combination of chlorine and oxygen, neither can the nitric or sulphuric acids be admitted as pure combinations of oxygen. This is perfectly obvious. An acid composed of five proportions of oxygen and one of nitrogen is altogether hypothetical; and it is a simple statement of facts to say, that liquid nitric acid is a compound of two proportions of hydrogen, one of azote, and six of oxygen; and, as I shewed long ago, the only difference between nitre and hyper-oxymuriate of potash is, that one contains a proportion of azote, and the other a proportion of chlorine.

There are very few of the substances which have been always considered as neutral salts, that really contain the acids and the alkalies from which they are formed. The muriates and the fluates must be admitted to contain neither acids nor alkaline bases. Most of the prussiates M. Gay Lussac has lately shewn are in the same case. Nitric and sulphuric acids cannot be procured from the nitrates and sulphates without the intervention of bodies containing hydrogen; and if nitrate of ammonia were to be judged of from the results of its decomposition, it must be regarded as a compound of water and nitrous oxyd.

Only those acids which are compounds of oxygen and inflammable bases appear to enter into combination with the fixed alkalies and alkaline earths without alteration, and it is impossible to define the nature of the arrangement of the elements in their neutral compounds. The phosphate and carbonate of lime have much less of the characters attributed to neutrosaline bodies than calcane (muriate of lime), and yet this last body is not known to contain either acid or alkaline matter. The chloriodic acid,

acid, the phosgenic acid, and the binary acids containing hydrogen, combine with ammonia without decomposition, but they appear to be decomposed in acting upon the fixed alkalies or alkaline earths; and yet the solid substances they form have all the characters which were formerly regarded as peculiar to neutral salts consisting of acids and alkalies, though they none of them contain the acid, and only the two first of the series the alkalies, from which they are formed.

The substitution of analogy for fact is the bane of chemical philosophy; the legitimate use of analogy is to connect facts together, and to guide to new experiments.

As I cannot adopt M. Gay Lussac's opinions, so neither can I approve of his nomenclature. To call the compounds of chlorine and iodine, chlorures and iodures, is to place chlorine and iodine in the class of inflammable bodies, and I prefer to these denominations chlorides and iodes. M. Gay Lussac has called sulphuretted hydrogen, hydrosulphuric acid; a term which has already been applied to sulphuric acid, the oil of vitriol of commerce. Hydro-chloric acid would signify chloric acid combined with water, and therefore, according to M. Gay Lussac's own views, is more applicable to his chloric acid than to muriatic acid.

On preventing Hares and Rabbits from attacking the Bark of Trees.

By Mr. Joseph Smeall, *Gardener, Millburn-Tower.*

From the Transactions of the Caledonian Horticultural Society.

When I came to Mr. Liston's service six years ago, I found that the young apple and pear trees which had been previously planted in the garden, were much in-

jured by hares and rabbits eating the bark during the winter season. I endeavoured to find out a remedy, and am happy to think that I have completely succeeded. It is very simple, and attended with little expence, and I beg leave to communicate it to you, for the benefit of the members of the society.

Take hog's-lard, and as much whale oil as will work it up to a thin paste or paint. With this, gently rub the stems of the trees upwards, at the fall of the leaf. This may be done once in two years, and will be found effectually to prevent either hares or rabbits from touching them.

The innocent nature of the ingredients of which the composition is made, renders it unnecessary for me to say, that the trees are not injured by the application in the slightest degree.

Description of a Centrifugal Pump, invented by M. JOHN VICTOR JORGE, *Lieutenant-Captain in the Portuguese Service.*

From LES ANNALES DE CHIMIE ET DE PHYSIQUE.

THIS pump was presented to the Academy of Sciences at Paris, and MM. de Rossel appointed to make a report of it. Suppose a pipe open at both ends and bended in the middle in a given angle, to have one of its branches plunged to a certain depth below the surface of the water in a reservoir, while the other branch rises above the surface to a certain height; it is clear that the water will fill the first of these branches, and that it will rise in the second up to the level of the reservoir.

The better to convey these ideas, let us imagine that these two branches are bended at right angles to each other,

other, and that the branch of this kind of square which is immersed must be horizontal. Let us suppose again that the bended tube is fastened to a vertical axis, situated in the plane of the branch immersed, and on the side of its opening, and that a rotary motion is given to it round this axis; in this case all the particles of the fluid contained in the horizontal branch of the pipe, will, in virtue of this rotary motion, be excited by a centrifugal force, with the weight of which they will press the base of the column of water contained in the vertical branch; for in all other directions the effect of the pressure would be destroyed by the resistance of the metal of the tubes. The water will then rise in the vertical tube above the surface of the reservoir to the height, when the weight of the highest liquid column will make an equilibrium to the weight of the centrifugal force with which its base is pressed.

We may then imagine, by augmenting or diminishing the velocity of this rotary motion of the system, how the height, to which the water is raised above the surface of the reservoir, can be increased or diminished. It is seen also, that if the height of the vertical tube is less than that to which the centrifugal force of the column immersed is capable of supporting the ascending column, that there will be a constant flow of fluid by the superior aperture of the tube, and according to this principle the water of the reservoir may be raised above its level, and may be received into a circular spout, from whence it may be taken as it is wanted.

We may suppose that the horizontal branch of the bended pipe, instead of being plunged in the fluid and moving in a circular direction, is placed above the surface of the reservoir, still remaining in communication with the vertical branch, whose axis will then become the

rotary

rotary axis; if we suppose a vacuum made in the pipe, the pressure of the atmosphere on the surface of the reservoir will oblige the water to rise into the vertical branch, and will fill the horizontal tube, provided its height above the reservoir does not exceed thirty-two feet.

In this state, still supposing the machine in motion around the vertical axis of the ascending tube whose open end is plunged in the fluid, it may be conceived, that, if the aperture of the horizontal branch should be opened, the centrifugal force would force out a certain quantity of fluid, which would be constantly replaced by an equal quantity, which the pressure of the atmosphere would force into the apparatus.

It is now only necessary to find out the method of making this vacuum; but it is evident the same effect may be obtained, if we can succeed in placing the apparatus in that situation, when the vacuum being already formed, the pressure of the atmosphere makes the volume of water which is necessary to fill it rise in the perpendicular tube.

Mr. Erskine, to whom the English attribute the invention of this pump, places a valve to the inferior extremity of the vertical tube, which can only open upwards like those in common sucking pumps; he likewise adds to its upper part two horizontal arms furnished with two valves which open outwards, and which are applied momentarily to their apertures by means of springs, while all the apparatus is filled, with the assistance of small holes bored in this arm, and which can be immediately closed by means of screw plugs. The apparatus is then put into motion, and the water escapes from the horizontal branches, while the pressure of the atmosphere forcing the lower valve open, by a continual motion replaces the water

water which overflows by a constant rise up of the ascendant tube. The greatest inconvenience which appears in this centrifugal pump, arises from the necessity of overcoming the inertia of the cylindical suction pipe, turning on its own axis with considerable velocity, as well as the friction on the pivots.

M. Jorge has succeeded partly in removing these inconveniencies by his invention, which consists in making the suction pipe of the pump stationary, and only to put the transverse revolving branches of the apparatus in motion above the pipe; by this means, the inertia which the moving force must overcome, is reduced to that part of the machine, which is indispensably necessary to be put in motion. The suction pipe may be inclined as occasion requires, and may take any direction, or it may be placed in any local situation where a vertical pipe could not be fixed.

List of Patents for Inventions, &c.

(Continued from Page 64.)

John Dyson, of Watford, Hertfordshire; for certain apparatus for the culture and tillage of land. Dated May 26, 1818.

Charles Greenway, of Manchester, Lancashire, Cotton Spinner; for an improvement in the operation of opening raw cotton or cotton wool previous to the carding and spinning the same; and by which improvements such operation will be facilitated. Dated May 26, 1818.

George Michall, of St. Austle, Cornwall, Builder; for improvements in the method of opening and shutting windows or sashes; and also in the application of machinery

chinery to the opening and shutting window shutters, and in other cases where the aforesaid improvements may be applied. Dated May 26, 1818.

Henry Taylor, of Kingston, Surrey, Gentleman; for improvements on machines or apparatus for catching and destroying rats and other vermin. Dated May 26, 1818.

Thomas Homfray, of the Hyde, Kinfare, Staffordshire, Iron-master; for a new kind of bobbin or bobbins used in spinning and other manufactories. Dated May 28, 1818.

William Lester, of the Commercial Road, Middlesex, Engineer; for a method of encreasing and projecting light produced by lamps or other means. Dated June 2, 1818.

George Atkinson, of Leeds, Yorkshire, Canvas-manufacturer; for a combination of materials to produce an article resembling bombazeen. Dated June 10, 1818.

William Eaton, of Wiln Mills, Derbyshire, Cotton-spinner; for improvements in certain parts of the machinery employed in the roving and spinning of cotton and wool. Dated June 18, 1818.

Robert Winch, of Shoe-lane, London, Printers' Carpenter and Press-maker, and Richard Holden, of Stafford-street, St. Mary-le-bone, Middlesex, Gentleman; for machinery to communicate motion and power to various other machinery which requires reciprocating or alternating motion. Dated June 18, 1818.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CXCV. SECOND SERIES. August 1818.

Specification of the Patent granted to JOSHUA ROUTLEDGE, *of Bolton-le-Moors, in the County of Lancaster, Engineer; for an Improvement or Improvements upon the Rotary Steam Engine.*

Dated February 27, 1818.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Joshua Routledge do hereby declare that my said invention is fully described and ascertained by the drawings in the margin of these presents, and the following description thereof; that is to say: Fig. 1 (Plate V.) exhibits a front view of the engine, with one of its ends taken off to shew its internal parts. A A A A, is a wide short cylinder of cast-iron, brass, or any other suitable material, to be bored very true on the inside, and to be made of any dimensions according to the power required. B *b b b* is an arm or lever, answering the same purpose as a piston in other engines, and is propelled forward by the steam in a circular direction, turning upon its axis as a centre. Two arms or levers may be applied as occasion may require; C is the steam stop,

and is to prevent the steam from escaping towards the side C, until the arm or arms, lever or levers, has or have made an entire revolution; D is a square box or chamber (cast upon the cylinder) where the steam stop C is deposited during the time that the point B *b* of the arm or lever is passing by; G is the steam-pipe coming from the boiler which admits the steam into the engine, and H is the exhausting pipe, by which the steam passes off into the condenser, or into the open air, as will be hereafter explained; I I I I is a groove or recess, where packing of hemp, metals, or any other proper and suitable material or materials, is or are to be introduced, in order to render the arm or lever steam tight; P shews a recess for the same purpose in the steam stop C; E E is a strong foot or bracket, cast upon the cylinder, by which it is firmly fixed down upon a strong foundation, either of masonry, framing of wood, cast-iron, or a combination of any or all of them. Fig. 2 exhibits a section across the engine at *a a*, the same letters referring to the same things; it likewise shews the two ends L L, with their stuffing boxes K K, and the manner they are fitted into the cylinder; at *c c c c*, a groove or rabbet is bored or made to a convenient depth to receive the two ends L L, which are to be truly turned or formed to fit the rabbet; and the joint on each side is to be made air tight by two circular rings, sections of which are shewn at *d d d d*. Upon the shaft or centre F, a fly-wheel is to be fixed, and at N N two necks or jurnals are to be made to rest upon two strong standards or bearings to be firmly fastened down to the same foundation as the foot or bracket E E. The machinery to be moved by the engine may be attached to either or both ends of the shaft F, as may be found desirable. Fig. 3 exhibits a face or front view of the steam stop C, shewing the recess P P P

on

on three sides where the packing is put in to make it steam-tight, and O is the centre on which it turns in going up into the chamber D. Fig. 4 exhibits a section of the chamber D, shewing the situation of the stop C, when turned up, where it forms a part of the periphery of the cylinder A A A A.

The operation of the engine is as follows: suppose the steam-stop C and the lever B *b b b* to be properly packed in the situation represented by the drawing, so that the steam cannot escape past either one or the other, it will be evident that if the steam is admitted through the pipe G into the space M, the lever B *b b b* will be propelled forward towards C through the space Q, until the sloping part B comes in contact with the lower point of the steam-stop C, which will then turn upon a steam-tight joint or centre O, and rise up into the box or chamber D until the lever B *b b b* has passed by; the pressure of the steam then compels the stop C to follow the lever down the inclined plane *b*, until it comes into its former resting place, where it remains stationary upon the cylindrical part of the lever, as seen in the drawing Fig. 1, until again raised by the sloping part B as before. During the time that the point B *b* is passing the steam stop C, the steam that had last carried the lever round, makes its escape through the pipe H, either into the open air or into a condenser, and new steam is again instantly admitted, and so on continually. When the engine is constructed with only one arm or lever, there is about one-tenth of the circle or revolution where the steam has no power; the motion of the engine is then kept up by the velocity already given to the fly-wheel, but when two arms or levers are used, which will mostly be the case, especially in large engines, then the steam is made to act with equal force through the whole of the revolution.

I purpose to use my invention either as a condensing engine, with a condenser and air or discharging pump, or as a high pressure engine without a condenser or discharging pump, working entirely by the high pressure of the steam without the aid of vacuum; when I make use of it as a high pressure engine, no other apparatus is necessary than what is represented in the drawings in the margin hereof, excepting a fly-wheel and a strong foundation for the engine to rest upon; in this case the steam is discharged into the open air or into a cistern of water, to heat it for the supply of the boiler, or for any other purpose where hot water may be required. When it is constructed for a condensing engine, another pipe is to be joined to the pipe H, to connect the cylinder A A A A with the condensing vessel in the usual way; but the air or discharging pump I construct in the same form and on the same principle as the engine, only with this difference, that the receiving pipe in the engine becomes the discharging pipe in the pump, and the discharging pipe in the engine is made the receiving or suction pipe in the pump, and is turned in a contrary direction to the engine.

I purpose also to make use of this my invention for the ordinary purposes of pumping for which pumps of the common construction are applicable; and what I claim as my invention particularly, is the arms or levers, the steam stop, and the way and manner I make use of them as a steam engine and pump, as above described and ascertained by the drawings in the margin of these presents; but the form of them may be varied as may be found convenient. And I do further declare that this my invention as a steam engine, is applicable to all the purposes of giving motion to machinery by means of its centre or axis, wherever such power may be required.

In witness whereof, &c.

Specification

Mr. Routledge's Patent

Fig. 1.

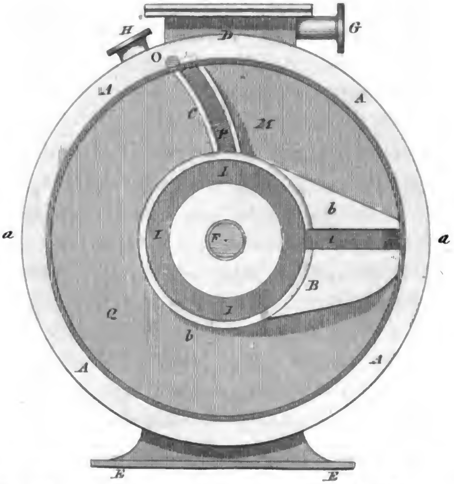


Fig. 3.

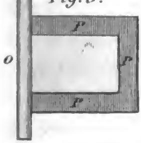
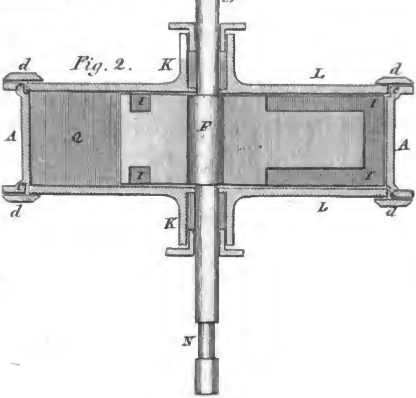


Fig. 4.

Fig. 2.



Specification of the Patent granted to ANTHONY HILL, *of Plymouth Iron Works, in the County of Glamorgan, Iron Master; for certain Improvements in the Smelting and Working of Iron.* Dated July 26, 1814.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Anthony Hill do hereby declare, that the nature of my said invention, and manner of performing the same, are fully described and ascertained in manner following; that is to say: My said improvements do consist in the manipulations, processes, and means hereinafter described and set forth, and by which the iron contained in the several sorts of slags or cinders produced in or obtained from the refinery furnace, the puddling furnace, and the balling or re-heating furnace, and which are produced in consequence of, or by, or during the operations of rolling, or by any treatment to which the crude or pig-iron of the blast furnace may be or is usually subjected, in order to improve or alter the quality of the same, is by smelting and working, made into or brought into the state of bar-iron, whether only one of the said several sorts of slags or cinders be used, or whether all the said sorts of the said slags or cinders, or any of the said several sorts of them, be mixed together and used, or whether all the said sorts of the said slags or cinders, or any one or more of the said sorts of them be compounded with iron stones, or iron ores, or with both of them; whether all the said several compounds be used together, or whether only one or more of the said several compounds be used, or whether only one of the several sorts of crude or pig-iron obtained from the said slags or cinders, or the aforesaid mixtures of them

them be used; or whether all or any of the said several sorts of crude or pig-iron be mixed and used together; or whether they or any one or more of them be mixed with one or more sort or sorts of any other crude or pig-iron and used; or whether only one of the several sorts of crude or pig-iron obtained from all, or any, or either of the said compounds of the said slags or cinders, with iron stones or ores, be used; or whether all or any of the said last mentioned several sorts of crude or pig-iron be mixed and used together; or whether they or any one or more of them be mixed with any one or more sort or sorts of any other crude or pig-iron, and used; or whether all, or any, or either of the aforesaid sorts of crude or pig-iron be compounded, and used with refined metal obtained from the said slags or cinders, or from the said mixtures thereof, or from the said compounds of the said slags or cinders with iron stones and ores, or with the refined metal or any other iron; or whether only one of the several sorts of refined metal obtained from the said slags or cinders, or from the said mixtures thereof, or from the said last-mentioned compounds, be used; or whether all or any of the said last-mentioned refined metals be mixed and used together; or whether any, or any one or more of them be mixed with any one or more sort or sorts of refined metal, or any other iron, and used; or whether only one of the several sorts of puddled iron obtained from the said slags or cinders, or from the said mixtures thereof, or from the said last-mentioned compounds, be used; or whether all or any of the said last-mentioned puddled irons be mixed and used together; or whether they or any one or more of them be mixed with any one or more sort or sorts of any other puddled iron, and used. And that my said improvements do further consist in the use and application of lime to

iron

iron subsequently to the operations of the blast furnace, whereby that quality in iron from which the iron is called "cold short," however, and from whatever substance such iron be obtained, is sufficiently prevented or remedied, and by which such iron is rendered more tough when cold. And I do further declare, that in the said smelting and working I do use a mixture of lime or limestone, and of the substance in which the iron stones are generally found, and which is known in South Wales by the name of mine rubbish, whether raw or calcined, consisting by weight of about six parts of good limestone to five parts of raw mine rubbish, which said mixture I do apply together with the other materials operated upon in the blast furnace for the purpose of producing a fusible cinder; and that the proportions of the said limestone and mine rubbish composing the said mixture may be varied, without materially impairing the beneficial effects thereof. And that in smelting and working by the usual working of the blast furnace, all or any or either of the said sorts of the said slags or cinders, or the aforesaid mixtures of them, or all, or any, or either of the said compounds thereof with iron stones or ores, when such slags or cinders, or compounds last-mentioned, are known by assay or otherwise, to be capable of affording crude or pig-iron to the amount of fifty *per cent.* or thereabouts by weight; I do, in order to make one charge, take and use eighteen cubic feet by measure, or about four hundred and fifty pounds by weight, of coke; and from three hundred pounds to four hundred and twenty pounds of the said slags or cinders, or the said last-mentioned mixtures or compounds; and from seventy pounds to ninety-five pounds of the said raw mine rubbish; and from one hundred and eighty pounds to two hundred and forty pounds of the said limestone, or from one hundred and

ten

ten pounds to one hundred and forty-five pounds of lime; which charge I do repeat according to the usual manner of filling and working the blast furnace; but, that when the said slags or cinders, or the said last-mentioned mixtures or compounds, which are known by assay or otherwise, to contain respectively either more or less than fifty *per cent.* by weight of crude or pig-iron, are required to be smelted and worked by the usual working of the blast furnace, it will be necessary, in order to produce the best effect, that the quantity and proportions thereof, and of the limestone and raw mine rubbish to be made use of in the charge as aforesaid, should be varied; and that as a general rule of practice to be adopted and followed, I declare that I do mix all, or any, or either of the said sorts of the said slags or cinders with raw mine rubbish if required, or I do mix all, or any, or either of the said last-mentioned compounds with raw mine rubbish if required, until the crude or pig-iron contained in either of such aggregate mixtures shall amount to about forty *per cent.*, or less than forty *per cent.* if so wished; and then in order to constitute a charge, I do take from either or both of such aggregate mixtures, from three hundred and fifty pounds to five hundred and fifty pounds in the whole, and eighteen cubic feet by measure, or about four hundred and fifty pounds by weight of coke; and I do flux the whole by adding six parts by weight of limestone for every five of such parts of the raw mine rubbish, as may have been used for the purpose last before-mentioned; and I do add so much more lime or limestone as may be known by assay, or otherwise to be required to produce a fusible cinder; and further, that it will be adviseable to reduce the said slags or cinders, or the said mixtures of the said slags or cinders, or the said compounds of the said slags or cinders, with the said

iron

iron stones and ores, and the limestone and raw mine rubbish aforesaid, previous to their being put into the blast furnace, to about the size at which materials are commonly used in the blast furnace; and further, I do draw off from the blast furnace the crude or pig-iron afforded by the said slags or cinders, or by the said last-mentioned mixtures or compounds; and I do make the several sorts of crude or pig-iron obtained from the said slags or cinders, or from the said last-mentioned mixtures or compounds, into bar-iron, by puddling, re-heating, and rolling, compressing or hammering, or by refining, puddling, re-heating and rolling, compressing or hammering, whether only one of the said several sorts of crude or pig-iron be used, or whether all or any of the said several sorts of crude or pig-iron be mixed and used together, or whether they or any one or more of them be mixed with any one or more sort or sorts of any other crude or pig-iron and used, or whether all or any, or either of the aforesaid sorts of crude or pig-iron be compounded, and used with refined metal obtained from the said slags or cinders, or from the said mixtures thereof, or from the said compounds of the said slags or cinders, with iron stones or ores, or with refined metal of any other iron, and used, or whether only one of the several sorts of refined metal obtained from the said slags or cinders, or from the said mixtures thereof, or from the said last-mentioned compounds, be used, or whether all or any of the said last-mentioned refined metals be mixed and used together; or whether they or any one or more of them be mixed with any one or more sort or sorts of refined metal from any other iron, and used; or whether only one of the several sorts of puddled iron obtained from the said slags or cinders, or from the said mixtures

thereof, or from the said last-mentioned compounds, be used; or whether all or any of the said last-mentioned puddled irons be mixed and used together; or whether they, or any one or more of them be mixed with any one or more sort or sorts of any other puddled iron, and used. And I do further declare that I have discovered that the addition of lime or limestone, or other substances consisting chiefly of lime, and free or nearly from an ingredient known to be hurtful to the quality of iron, will sufficiently prevent or remedy that quality in iron from which the iron is called cold short, and will render such iron more tough when cold; and I do for this purpose, if the iron, howsoever, and from whatever substance the same may have been obtained, be expected to prove cold short, add a portion of lime or limestone, or of the other said substances, of which the quantity must be regulated by the quality of the iron to be operated upon, and by the quality of iron wished to be produced; and further, that the said lime or limestone, or other aforesaid substances, may be added to the iron at any time subsequently to the reduction thereof in the blast furnace, and prior to the iron becoming clotted or coming into nature; whether the same be added to the iron while it is in the refining furnace or in the puddling furnace, or in both of them, or previous to the said iron being put into either of the said furnaces; and further, that I do in preference add quick-lime instead of limestone, or the said other substances (either of which as to quantity, whensoever and howsoever so used, may be considerably varied) to the iron in the refinery furnace and in the puddling furnace. And I do further declare that I do greatly prefer to mix or add in the refinery furnace about from one-fourth to one-third by weight of the crude or pig-

iron,

iron, which has been obtained from the slags or cinders, with three-fourths or two-thirds of the crude or pig-iron which has been obtained from the iron stones. And I do further declare, that for the operation in the refinery furnace, I do add the lime as it is obtained from the kiln, in the proportion of from one-sixtieth to one-fortieth part of the whole weight of the crude or pig-iron intended to be worked in the furnace; and I apply about one half of the said lime, together with the crude or pig-iron as it is thrown from the refinery fire, and the remainder from time to time during the course of the refinery operation, taking care not to suffer the slag or cinder, which is produced to get too thick, nor to endanger the stopping up of the furnace. And I do also declare, that in the puddling furnace I further add lime in the proportion of from one-hundredth part to one-eightieth part by weight of the whole weight of the iron in the furnace, which lime I previously slake and wet to prevent its being carried off by the draft of the furnace. And I do apply the same in the course of that part of the operation which is known to workmen by the term "drying the iron." And moreover, I take care that the same shall be intimately mixed with, and minutely dispersed through the iron by the usual operations of puddling.

In witness whereof, &c.

Specification of the Patent granted to BENJAMIN SMYTHE, *of Liverpool, in the County of Lancaster, Schoolmaster; for a Machine or Apparatus, or a new Method or Methods of propelling Vessels, Boats, Barges, and Rafts of all Kinds; and also other Machinery, as Mill Wheels and other revolving Powers.*

Dated November 1, 1816.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Benjamin Smythe do hereby declare that my said invention is described in manner following, and by the drawing hereunto annexed, and the reference thereto; that is to say: In the first place my said invention is established upon a mathematical theorem, which may be comprehended in the following words, *viz.* If three equal cranks in the same horizontal plane, or in planes parallel to each other, be conceived to revolve each upon its respective centre in the same plane, with one and the same uniform velocity and in the same direction; with regard to the parts of the cranks alike situated, and any part being taken on the outer bend or extremity of the middle crank, and a right line drawn from that point parallel to a line supposed to join the centres of the cranks, until it meets the outer extremity or bend of the other two cranks; then I say the right line so drawn will be equal and continue equal to the line of distance during the whole of every revolution so made. This line in the machine I call the connecting rod; the demonstrative principles of the foregoing theorem is sufficiently explained by the annexed drawings, and the references thereto, to enable any intelligent engineer,

gineer, shipwright, or mechanic to construct my apparatus for propelling vessels, and to adopt the said apparatus, or others on the same principles, to mill wheels and other revolving powers.

In the annexed drawing, Fig. 1, *a a*, *d d*, are the middle impelling cranks, which are put in motion by the spur-wheel A; when these middle impelling cranks are put in motion or turned by the wheel A, so as to bring the part of the cranks represented at *a a* into a vertical position, the other end of the same cranks, as at *d d*, will be down in the water, each crank carrying with it at the same time, by means of the connecting rods 2, 2, 2, 2, 2, 2, 2, 2, the other two cranks *e e*, *e e*, and *c c*, *c c*, on both the sides of the vessel, preserving at the same time, by means of the connecting rods, a regular rotatory parallel motion which dips into the water alternately the paddles *i i i* on each connecting rod, by which motion the vessel is impelled through the water, either by steam engines or any other impelling force.

Fig. 2, is intended to shew two different methods of using *two* cranks on the outside of the vessel instead of *three*, which are calculated to produce the same effect without taking up so much length on the outside of the vessel, a convenience which will be of peculiar advantage in short vessels, which the three connected cranks in Fig. 1, could not possess when they are in one horizontal plane; yet by raising or lowering the middle crank in Fig. 1, above or below the same plane of the other two cranks, the distance taken up on the outside may be considerably less. In Fig. 2, as above-mentioned, there are two different methods of using or connecting the two outer cranks with the three small inner or outer cranks; the one on the inside of the vessel which cannot be so conveniently put to practice, or so safe at sea (on account

of

of having both the sides of the vessel to perforate in two different places, to connect the three inner cranks with the two outer), the three outside short cranks connected with the two outside ones is on that account preferable, as there is no need for more than the *middle shaft* or connecting part of the crank going across the vessel, and through the sides, on account of the other two cranks being made to pedestal on the outside as at *n n*, Fig. 2. Although there are *two different* plans or methods of arranging the cranks in this figure, it is still to be understood that only *one* method is to be used at one and the same time, *viz.* when the outside small cranks *n n n n* are used, the inside cranks in the frame *a* must be taken away, and the middle part or weeel-shaft continued through both sides and across the middle of the vessel to the small cranks on the outside. When the inside cranks in the frame *a* are used, the cranks *n n n n* on the *outside* must also be taken away in like manner, and the two cranks continued athwart the vessel as at *c c*, Fig. 2. As both these sets were not intended to be used together, but merely to shew the different ways of constructing them, the above explanation will be sufficient.

Fig. 3 is an elevation of a single connecting rod with the small rods *a a a a*, which are fastened to each paddle with an hinge, so as to turn up all the paddles into an horizontal position when the vessel is under sail, and thereby raise the paddles more effectually out of the water, provided they are not sufficiently so when both the cranks and connecting rods on each side of the vessel are put in an horizontal position. In Fig. 1, I have shewn the way the double connecting rods 2 on each of the cranks may be fixed with the paddles *i*, between each of the connecting rods upon the same crank. I have drawn this merely to shew that two connecting rods upon

one

one crank may be used; but I by no means consider them equal to the single one unless in low vessels, where it is impossible to do without dipping the rods in the water with the paddles; in all other respects I prefer the connecting rod Fig. 3, or some other upon a similar plan and principle.

Figs. 4 and 5 are the side and back view of the circular paddles, with their bolts upon the top to fix them to the connecting rod, and hinges *e e e e* on the back and inside, to which the stays *a a a a a* are fixed, for the purpose of turning up the paddles; *d d* are the two screws, and their nuts for holding the stays in the proper place. These paddles, cranks, connecting rods, pedestals, caps, and bushes, and all other things thereto belonging, may be made of wood, iron, brass, or any other material used for machinery of a similar nature.

With regard to mill wheels and other revolving powers, I construct my apparatus in the following manner, *viz.* instead of two cranks both bent in an horizontal plane with regard to each other, which are used to propel small vessels as above mentioned in Fig. 2, I have three cranks as represented in Fig. 1, propelled or carried round by the paddles and connecting rod, so as to turn any wheel, crank, or other machinery that can be fixed up on the middle crank or shaft, and thereby giving such wheel, crank, &c. &c. a revolution, same as the common water wheel. These cranks have four bends on each; these bends or cranks are at right angles with each other, so as to form a set of connecting rods that will answer the purpose of a water wheel with four arms or paddles; each of these connecting rods is fixed upon the cranks in the same way as they are in Fig. 1 of the boat, with only this difference, *viz.* the mill wheel has four connecting rods which revolve parallel to each other upon each crank, and

and each remaining during every such revolution in its own course or channel, turning such machinery as may be attached to it by the water running against the hollow side of the paddles upon each connecting rod in regular rotation. Wheels and the paddles of the boat are carried round by steam or any other mechanical agent, so as to propel the vessel through the water. Two cranks in the same horizontal plane with each other, or four cranks at right angles with each other, or more cranks at any other angle, may be used for propelling large vessels, or diving heavy machinery.

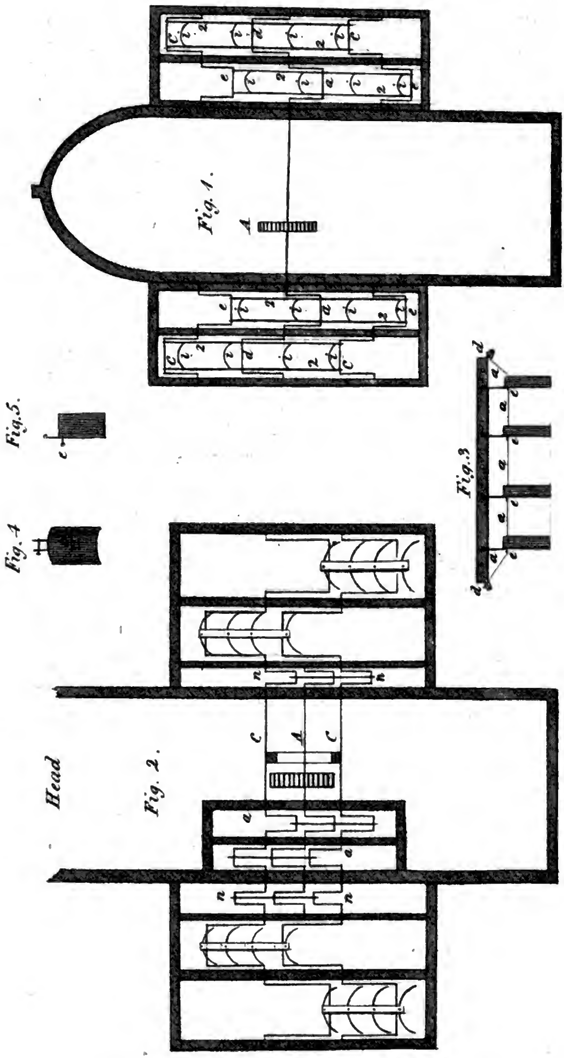
The principle of this invention consists in the parallel rotation of a connecting rod or rods, which may be impelled either by steam or other power acting upon the cranks, so as to force the paddles upon the cranks and connecting rods into and against the water in *propelling vessels*, or by the water running against the hollow or inside of the paddles, so as to turn the cranks and other machinery when used as *mill wheels*, &c. &c.

In witness whereof, &c.

*** The Patentee begs leave to observe that this invention is particularly adapted for perpetual stream pumps, for which he is now using it.

History

Mr. Smythe's Patent



History of Dr. Brewster's *Kaleidoscope, with Remarks on its supposed Resemblance to other Combinations of Plain Mirrors.*

Communicated by Mr. Bates, *Optician.*

In the year 1814, when Dr. Brewster was engaged in experiments on the polarisation of light by successive reflections between plates of glass, which were published in the Philosophical Transactions for 1815, and honoured by the Royal Society of London with the Copley Medal, the reflectors were in some cases inclined to each other, and he had occasion to remark the circular arrangement of the images of a candle round a centre, or the multiplication of the sectors formed by the extremities of the glass plates. In repeating, at a subsequent period, the experiments of M. Biot on the action of fluids upon light, Dr. Brewster placed the fluids in a trough formed by two plates of glass cemented together at an angle. The eye being necessarily placed at one end, some of the cement which had been pressed through between the plates appeared to be arranged into a regular figure. The symmetry of this figure being very remarkable, Dr. Brewster set himself to investigate the cause of the phenomenon, and in doing this he discovered the leading principles of the kaleidoscope. He found that in order to produce perfectly beautiful and symmetrical forms three conditions were necessary.

1. That the reflectors should be placed at an angle, which was an *even* or an *odd* aliquot part of a circle, when the object was regular, and wholly included in the aperture; or the *even* aliquot part of a circle when the object was irregular.

 2. That

2. That out of an infinite number of positions for the object both within and without the reflectors, there was *only one* position where perfect symmetry could be obtained, namely, by placing the object in contact with the ends of the reflectors.

3. That out of an infinite number of positions for the eye, there was *only one* where the symmetry was perfect, namely, as near as possible to the angular point, so that the circular field could be distinctly seen; and that this point was the *only one* out of an infinite number at which the uniformity of the light of the circular field was a maximum.

Upon these principles Dr. Brewster constructed an instrument, in which he fixed *permanently* across the ends of reflectors, pieces of coloured glass, and other irregular objects, and he shewed the instrument in this state to some Members of the Royal Society of Edinburgh, who were much struck with the beauty of its effects. In this case, however, the forms were nearly permanent, and a slight variation was produced by varying the position of the instrument, with respect to the light. The great step, however, towards the completion of the instrument remained yet to be made, and it was not till some time afterwards that the idea occurred to Dr. Brewster *of giving motion to objects, such as pieces of coloured glass, &c. which were either fixed or placed loosely in a cell at the end of the instrument.* When this idea was carried into execution, the kaleidoscope, in its *simple form*, was completed.

In this state, however, the kaleidoscope could not be considered as a general philosophical instrument of universal application; for it was incapable of producing beautiful forms unless the object was nearly in perfect contact with the end of the reflectors.

The

The next, and by far the most important step of the invention, was therefore to remove this limitation by employing a draw tube and lens, by means of which beautiful forms could be created from objects of all sizes, and at all distances from the observer. In this way the power of the kaleidoscope was indefinitely extended, and every object in nature could be introduced into the picture, in the same manner as if these objects had been reduced in size, and actually placed at the end of the reflectors.

When the instrument was brought to this state of perfection, Dr. Brewster was urged by his friends to secure the exclusive property of it by a patent, and he accordingly took out a patent for "A New Optical Instrument for creating and exhibiting beautiful forms." In the specification * of his patent he describes the kaleidoscope in two different forms. The first consists of two reflecting planes, put together according to the principles already described, and placed in a tube, with an eye-hole in the particular position which gives symmetry and a maximum uniformity of light, and with objects such as coloured glass, *placed in the position of symmetry, and put in motion either by a rotary movement, or by their own gravity, or by both combined.* The second form of the instrument, described in the specification, is, when the tube containing the reflectors is placed in a second tube, at the end of which is a convex lens which introduces into the picture objects of all magnitudes, and at every distance, as has been already described.

After the patent was signed, and the instruments in a state of forwardness, the gentleman who was employed to manufacture them under the patent, carried a kaleid-

* Published in vol. XXXI. of this work.

oscope to shew to the principal London Opticians, for the purpose of taking orders from them. These gentlemen naturally made one for their own use, and for the amusement of their friends; and the character of the instrument being thus made public, the tinmen and glaziers began to manufacture the detached parts of it, in order to evade the patent; while others manufactured and sold the instrument complete, without being aware that the exclusive property of it had been secured by a patent.

In this way the invasion of the patent right became general among that class of individuals against whom the law is seldom enforced but in its terrors. Some workmen of a higher class were encouraged to piracy by this universal opposition to the patent; but none of the respectable London opticians would yield to the clamours of their customers, to encroach upon the rights of an inventor, to whom they were at least indebted for a new and a lucrative article of trade.

In order to justify these piratical proceedings, it became necessary to search for some combinations of plain mirrors, which might be supposed to have a resemblance to Dr. Brewster's instrument; and it would have been strange indeed, if some theorem or experiment had not been discovered, which could have been used to impose upon the great crowd who are entirely ignorant of the principles and construction of optical instruments. There never was a popular invention, which the labours of envious individuals did not attempt to trace to some remote period; and in the present case, so many persons had hazarded their fortunes and their characters, that it became necessary to lay hold of something which could be construed into an anticipation of the kaleidoscope.

The first supposed anticipation of the kaleidoscope was found in Proposition XIII. and XIV. of Professor Wood's

Wood's Optics, where that learned author gives a mathematical investigation of the number and arrangement of the images formed by two reflectors, either inclined or parallel to each other. These theorems assign no position either to the eye or to the object, and do not even include the principle of inversion, which is absolutely necessary to the production of symmetrical forms. The theorems indeed are true, whatever be the position of the object or of the eye. In order to put this matter to rest, Dr. Brewster wrote a letter to Professor Wood, requesting him to say if he had any idea of the effects of the kaleidoscope when he wrote these propositions. To this letter Dr. Brewster received the following handsome and satisfactory answer:

"*St. John's, May 19th,* 1818.

"Sir, The propositions I have given relating to the number of images formed by plane reflectors inclined to each other, contain merely the mathematical calculation of their number and arrangement. *The effects produced by the kaleidoscope were never in my contamplation.* My attention has for some years been turned to other subjects, and I regret that I have not time to read your Optical Treatise, which I am sure would give me great pleasure. I am, Sir, your obedient humble servant,

"J. Wood."

The next supposed anticipation of the kaleidoscope was an instrument proposed by Mr. Bradley in 1717. This instrument consists of two large pieces of silvered looking-glass, *five inches wide* and *four inches high,* jointed together with hinges, and opening like a book. These plates being set upon a geometrical drawing, and the eye being placed in front of the mirrors, the lines of the drawing were seen multiplied by repeated reflections. This

This instrument was described long before by Kircher, and did not receive a single improvement from the hands of Bradley. It has been often made by the opticians, and was principally used for multiplying the human face, when placed between the mirrors; but no person ever thought of applying it to any purpose of utility, or of using it as an instrument of rational amusement, by the creation of beautiful forms. From the very construction of the instrument, indeed, it is quite incapable of producing any of the singular effects exhibited by the kaleidoscope. It gives, indeed, a series of reflected images arranged round a centre: but so does a pair of looking glasses placed angularly in an apartment, and so do the pieces of mirror glass with which jewellers multiply the wares exhibited at their windows. It might therefore be as gravely maintained that any of these combinations of mirrors was a kaleidoscope, as that Bradley's pair of plates was an anticipation of that instrument. As the similarity between the two has been maintained by ignorant and interested individuals, we shall be at some pains to explain to the reader the differences between these two instruments; and we shall do this, first, upon the supposition that the two instruments are applied to geometric lines upon paper.

1. In Bradley's instrument, the length is less than the breadth of the plates.	1. In the kaleidoscope, the length of the plates must be four, or five, or six times their breadth.
2. Bradley's instrument cannot be used with a tube.	2. The kaleidoscope cannot be used without a tube.
3. In Bradley's instrument, from the erroneous position of the eye, there is a great inequality of light in	3. In the kaleidoscope, the eye is placed so that the uniformity of light is a maximum, and the last sectors

in the sectors, and the last sectors are scarcely visible.	sectors are distinctly visible.
4. In Bradley's instrument, the figure consists of elliptical, and consequently unequal sectors.	4. In the kaleidoscope, all the sectors are equal, and compose a perfect circle, and the picture is perfectly symmetrical.
5. In Bradley's instrument, the unequal sectors *do not unite*, but are all separated from one another by a space equal to the thickness of the mirror glass.	5. In the kaleidoscope the equal sectors all unite into a complete and perfectly symmetrical figure.
6. In Bradley's instrument, the images reflected from the first surface interfere with those reflected from the second, and produce a confusion and overlapping of images entirely inconsistent with symmetry.	6. In the kaleidoscope, the secondary reflections are entirely removed, and therefore no confusion takes place.
7. In Bradley's instrument, the defects in the junction of the plates are all rendered visible by the erroneous position of the eye.	7. In the kaleidoscope, the eye is placed so that these defects of junction are invisible.

The reader will observe, that in this comparison the two instruments are supposed to be applied to *geometric lines upon paper*, and that this was *the only purpose* to which Bradley ever thought of applying his mirrors; yet the kaleidoscope is in every respect a superior instrument, even for that inferior purpose, and gives true symmetrical

metrical forms, which the other instrument is incapable of doing.

In the comparison which has now been made, we have degraded the kaleidoscope, by contrasting its effects with those which Bradley's instrument is capable of producing, for these effects are not worth the looking at. When we attempt to employ Bradley's instrument to produce the effects which have been so much admired in the kaleidoscope, namely, to produce beautiful forms from transparent or opaque coloured objects contained in a cell, and at the end of the reflectors, it fails so entirely, that no person has succeeded in the attempt. It is indeed quite impossible to produce by it the beautiful and symmetrical forms which the kaleidoscope displays. Had this been possible, Dr. Brewster's patent might have been invaded with impunity by every person who chose to manufacture Bradley's instrument; but this was never tried *, and for the best of all reasons, because nobody would have purchased it.

We trust that no person, who wishes to judge of this subject with candour, will form an opinion without having *actually seen and used* the instrument proposed by Bradley. Let any person take Bradley's plates, and, having set them at an angle of 30° or 22½°, place them upon a cell containing fragments of coloured glass, he will infallibly find that he cannot produce a picture of any

* In illustration of this argument, we may state the following fact. Mr. Carpenter of Birmingham, being anxious to evade Dr. Brewster's patent, at a time when the manufacture of the patent kaleidoscope was in the hands of another person, attempted to construct instruments in imitation of Bradley's. After exercising his ingenuity for some time, he abandoned the attempt as impracticable, and set off for Scotland for the purpose of offering his services in manufacturing the patent instrument.

symmetry

symmetry or beauty. The disunion of the sectors, the darkness of the last reflections, and the enormous deviation from symmetry, towards the centre of the figure, will convince him, if he required conviction, that the instrument is entirely useless as a kaleidoscope. To those, however, who are not capable, either for want of knowledge, or want of time, to make such a comparison, we may present the opinion of three of the most eminent natural philosophers of the present day, viz. the celebrated Mr. Watt, Professor Playfair, and Professor Pictet.

"It has been said here," says Mr. Watt, "that you took the idea of the kaleidoscope from an old book on gardening. My friend, the Rev. Mr. Corrie, has procured me a sight of the book. It is Bradley's Improvements of Planting and Gardening. London 1731, part 2d. chap. 1st. It consists of two pieces of looking glass of equal bigness, of the figure of a long square, five inches long and four inches high, hinged together, upon one of the narrow sides, so as to open and shut like the leaves of a book, which, being set upon their edges upon a drawing, will shew it multiplied by repeated reflections. This instrument I have seen in my father's possession 70 years ago, and frequently since, but what has become of it I know not. In my opinion, the application of the principle is very different from that of your kaleidoscope."

The following is Professor Playfair's opinion:

"*Edinburgh*, 11*th May* 1818.

"I have examined the kaleidoscope invented by Dr. Brewster, and compared it with the description of an instrument which it has been said to resemble, constructed

by

by Bradley in 1717. I have also compared its effect with an experiment to which it may be thought to have some analogy, described by Mr. Wood in his Optics, Proposition 13 and 14.

"From both these contrivances, and from every optical instrument with which I am acquainted, the kaleidoscope appears to differ essentially both in its effect and in the principles of its construction.

"As to the effect, the thing produced by the kaleidoscope is a series of figures presented with the most perfect symmetry, so as always to compose a whole, in which nothing is wanting and nothing redundant. It matters not what the object be to which the instrument is directed, if it only be in its proper place, the effect just described is sure to take place, and with an endless variety. In this respect, the kaleidoscope appears to be quite singular among optical instruments. Neither the instrument of Bradley, nor the experiment or theorem in Wood's book, have any resemblance to this; they go no further than the multiplication of the figure.

"Next, as to the principle of construction, Dr. Brewster's instrument requires *a particular position of the eye of the observer, and of the object looked at,* in order to its effect. If either of these is wanting, the symmetry vanishes, and the figures are irregular and disunited. In the other two cases, no particular position, either for the eye or the object, is required.

"For these reasons, Dr. Brewster's invention seems to me quite unlike the other two. Indeed, as far as I know, it is quite singular among optical instruments; and it will be matter of sincere regret, if any imaginary or vague analogy, between it and other optical instruments, should be the means of depriving the Doctor of any part of the

reward

reward to which his skill, ingenuity, and perseverance, entitle him so well. JOHN PLAYFAIR,

Professor of Natural Philosophy in the University of Edinburgh.

"P. S.—Granting that there were a resemblance between the kaleidoscope and Bradley's instrument, in any of the particulars mentioned above, the introduction of coloured and moveable objects, at the end of the reflectors, is quite peculiar to Dr. Brewster's instrument. Besides this, a circumstance highly deserving of attention, is the use of two lenses and a draw tube, so that the action of the kaleidoscope is extended to objects of all sizes, and at all distances from the observer, and united, by that means, to the advantages of the telescope.

J. P."

Professor Pictet's opinion is stated in the following letter:

"SIR,

"Among your friends, I have not been one of the least painfully affected by the shameful invasion of your rights as an inventor, which I have been a witness of lately in London. Not only none of the allegations of the invaders of your patent, grounded on a pretended similarity between your kaleidoscope and Bradley's instrument, or such as Wood's or Harris' theories might have suggested, appear to me to have any real foundation; but, I can affirm that, neither in any of the French, German, or Italian authors, who, to my knowledge, have treated of optics, nor in Professor Charles' justly celebrated and most complete collection of optical instruments at Paris, have I read or seen any thing resembling your ingenious apparatus, which, from its numberless applications, and

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the pleasure it affords, and will continue to afford, to millions of beholders of its matchless effects, may be ranked among the most happy inventions science ever presented to the lovers of rational enjoyment.

M. A. Pictet,
Professor of Nat. Phil. in the
Academy of Geneva."

To Dr. Brewster.

The propositions in Harris' Optics relate, like Professor Wood's, merely to the multiplication and circular arrangement of the apertures or sectors formed by the inclined mirrors, and to the progress of a ray of light reflected between two inclined or parallel mirrors; and no allusion whatever is made, in the propositions themselves, to any instrument. In the proposition respecting the multiplication of the sectors, the eye of the observer is never once mentioned, and the proposition is true if the eye has an infinite number of positions; whereas, in the kaleidoscope, the eye can only have one position. In the other proposition (Proposition XVII.) respecting the progress of the rays, the eye and the object are actually stated to be placed *between the reflectors*; and even if the eye had been placed without the reflectors, as in the kaleidoscope, the position assigned it, at a great distance from the angular point, is a demonstration that Harris was *entirely ignorant of the positions of symmetry either for the object or the eye*, and could not have combined two reflectors so as to form a kaleidoscope for producing beautiful or symmetrical forms. The *only practical part* of Harris's propositions is the 5th and 6th scholia to Proposition XVII. In the 5th scholium he proposes a sort of catoptric box or cistula, known long before his time, composed of four mirrors, arranged in a most unscientific manner, and containing opaque objects *between the speculums*. "Whatever they are,"

are," says he, when speaking of the objects, "the upright figures between the speculums should be slender, and not too many in number, otherwise they will too much *obstruct the reflected rays from coming to the eye.*" This shews, in a most decisive manner, that Harris knew nothing of the kaleidoscope, and that he has not even improved the common catopric cistula, which had been known long before. The principle of inversion, and the positions of symmetry, were entirely unknown to him. In the 6th scholium, he speaks of rooms lined with looking-glasses, and of luminous amphitheatres, which, as the Editor of the Literary Journal observes, have been described and figured by all the old writers on optics *.

The persons who have pretended to compare Dr. Brewster's kaleidoscope with the combinations of plain mirrors described by preceding authors, have not only been utterly unacquainted with the principles of optics, but have not been at the trouble either of understanding the principles on which the patent kaleidoscope is constructed, or of examining the construction of the instrument itself. Because it contains two plain mirrors, they infer that it must be the same as every other instrument that contains two plain mirrors, and hence the same persons would, by a similar process of reasoning, have concluded that a telescope is a microscope, or that a pair of spectacles with a double lens is the same as a telescope or a microscope, because all these instruments contain two lenses. An astronomical telescope differs from a compound microscope only in having the lenses placed at

* The reader is requested to examine carefully the propositions in Harris' Optics, which he will find reprinted in the Literary Journal, No. 10. He will then be convinced, that Harris placed both the eye and the object between the mirrors, an arrangement which was known 100 years before his time.

different

different distances. The progress of the rays is exactly the same in both these instruments, and the effect in both is produced by the enlargement of the angle subtended by the object. Yet surely there is no person so senseless as to deny that he who first combined two lenses in such a manner as to discover the mountains of the moon, the satellites of Jupiter and Saturn, and all the wonders of the system of the universe, was the author of an original invention. He who produces effects which were never produced before, even by means which have been long known, is unquestionably an original inventor; and upon this principle alone can the telescope be considered as an invention different from the microscope. In the case of the kaleidoscope, the originality of the invention is far more striking. Every person admits that effects are produced by Dr. Brewster's instrument, of which no conception could have been previously formed. All those who saw it, acknowledged that they had never seen any thing resembling it before; and those very persons who had been possessors of Bradley's instrument, who had read Harris's Optics, and made his shew boxes, and who had used other combinations of plain mirrors, never supposed for a moment, that the pleasure which they derived from the kaleidoscope had any relation to the effects described by these authors.

No proof of the originality of the kaleidoscope could be stronger than the sensation which it excited in London and Paris. In the memory of man, no invention, and no work, whether addressed to the imagination or to the understanding, ever produced such an effect. A universal mania for the instrument seized all classes, from the lowest to the highest, from the most ignorant to the most learned, and every person not only felt, but ex-

pressed

pressed the feeling, that a new pleasure had been added to their existence.

If such an instrument had ever been known before, a similar sensation must have been excited, and it would not have been left to the ingenuity of the half learned and the half honest to search for the skeleton of the invention among the rubbish of the 16th and 17th centuries.

The individuals who have been most eager in this search, did not, perhaps, calculate the degree of mischief which they have done to those who have been led, upon their authority, to encroach upon the rights of others, and thus subject themselves to very serious consequences. The delay which has taken place in commencing legal proceedings, has not arisen from any doubt of the complete originality of the kaleidoscope, and of the defensibility of the patent. As soon as the patentee has made himself acquainted with the circumstance of the individuals who have invaded his patent, with the channels through which they have exported their instruments, and with the amount of the damage which they have done, he will seek for that redress which the law never fails to afford in cases of notorious and unprovoked piracy. We are well assured, that it never was the intention or the wish of Dr. Brewster to interfere with the operations of those poor individuals who have gained a livelihood from the manufacture of kaleidoscopes. We know that it will always be a source of no inconsiderable gratification to him, that he has given employment to thousands of persons, whom the pressure of the times had driven into indigence; and when a decision in favour of his patent is given, as no doubt will be the case, he will never think of enforcing it, excepting against that class of opulent pirates who have been actuated by

no

no other motive but the exorbitant love of gain, in wantonly encroaching upon the property of another.

The patent kaleidoscopes are now made in London, under Dr. Brewster's sanction, by Messrs. P. and G. Dollond, W. and S. Jones, Mr. R. B. Bate, Messrs. Thomas Harris and Son, Mr. Bancks, Mr. Berge, Mr. Thomas Jones, Mr. Blunt, Mr. Schmalcalder, Messrs. Watkins and Hill, and Mr. Smith. An account of the different forms in which these ingenious opticians have fitted up the kaleidoscope, and of the new contrivances by which they have given it additional value, will be published in Dr. Brewster's Treatise on the Kaleidoscope, now in the press. The public will see, from the examination of these instruments, how much they have been imposed upon by spurious imitations, sold at the most exorbitant prices, and made by individuals entirely ignorant, not only of the principles and construction of the instrument, but of the method of using it.

Method of seasoning Mahogany.

By Mr. JAMES CALLENDER, *of King's Head-court, Holborn.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Fifteen Guineas were voted to Mr. CALLENDER *for this Communication.*

I TAKE the liberty of submitting to the consideration of the Society of Arts a method of seasoning mahogany plank in a few hours, which hitherto has not been done in less than a year.

The importance of this method is considerable: in the first place, a considerable part of the capital which is invested

vested in wood lying to season, during many months, may be saved.

In the second place, as none of the small stuff, from two to six inches thick, is ever seasoned, according to the usual course of trade, all articles made of such wood, such as chairs, ballustrades, &c. must necessarily be excessively subject to warp, which is prevented by adopting my expeditious mode of seasoning. The following is the method I make use of. Having provided a steam-tight wooden box capable of holding conveniently such pieces of mahogany as are fit for chairs, &c. I adapt to it a pipe from a boiler, by means of which I fill the box (after the mahogany has been put into it) with steam, the temperature of which is about equal to that of boiling water.

The time required for inch-and-a-half wood is about two hours, and pieces of this thickness will become sufficiently dry to work after being placed in a warm room or workshop for twenty-four hours.

The wood by this treatment is somewhat improved in its general colour, and those blemishes which are technically called *green veins* are entirely removed.

It is also obvious, that the eggs or larvæ of any insects which may be contained in the wood, will be destroyed by the heat.

I have myself made use of the method described for a year and a half, and Mr. Dalziel, 26, Great James-street, Bedford-row, and Messrs. Gee and Hole, King-street, Holborn, have, by my advice, used the same practice with good success.

Mr. Dalziel and Mr. Gee attended the Committee according to summons, and stated that they had adopted the practice of steaming mahogany as communicated to them by Mr. Callender, and which was in their opinion

an original invention of the candidate. They farther said, that they had found by experience, that the method of steaming was an effectual way of seasoning small sized mahogany for chairs and other similar articles, and that mahogany so seasoned did not crack or warp by exposure to heat, a defect that wood, even after being seasoned in the ordinary way, is very liable to.

A piece of mahogany, abounding in green veins, had been sawn in two; one half had been exposed to steam, the other remained in its original state: the latter of these was declared by the above-mentioned cabinet-makers to be fit only for frame-work, while the former was, in their opinion, applicable to outside work.

The following Certificates also were delivered into the Committee, addressed to Mr. Callender.

CERTIFICATES.

You have known me in the wood trade sixteen years. I was twelve years prior to that time in the same trade; but I never heard (either among cabinet-makers, chairmakers, or any other branch in the wood line) of steam being applied either to hard or soft wood, to take out the sap or to season them.

Mulberry-court, Wilson-street, Moorfields, May 1, 1817. THOMAS SADGROVE.

N. B. I think if any thing of the kind had been practised I must have heard of it.

I have been upwards of twenty years in the mahogany trade, but never head of steam being applied for the purpose of drying mahogany.

35, *Maid-lane, Bankside, Southwark.* M. GILLCOCK.

I have

I have been above fifty-five years in the cabinet-making business, having served my apprenticeship to Mr. Seddon, of Aldersgate-street, where there were above 200 men employed in his manufactory; but I never heard of steam being applied for the purpose of drying wood, and should your method answer the purpose, it will be a most valuable acquisition to the trade.

9, *Clerkenwell Green.* GEORGE BIGGS.

Description of a Mill for grinding Flour.

By the Right Hon. Sir JOHN SINCLAIR, *Bart.*

With a Wood Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Thanks of the Society were voted to Sir JOHN SINCLAIR *for this Communication.*

THE French portable military mill, presented to the Society by the Right Hon. Sir John Sinclair, is one of many thousands which were used by the French armies in foreign service, and particularly in the Russian campaign, in which, from the length and rapidity of the march, it was manifest that as great a reduction as possible of the heavy baggage would be necessary. On examination by the Committee of Mechanics, it appeared to combine in an eminent degree the qualities of portability, of simplicity, and ingenuity of construction, of facility in making use of it, and of expedition in regard to the quantity of work done. The Society, adopting the recommendation of the Committee, resolved that a description of it should be inserted in their annual volume,

in the hopes that it might be found useful, not only in an army on active foreign service, but in workhouses, in prisons, in schools, and in private families. An ingenious mechanic, a member of the Society, has already manufactured a considerable number, which, from the ready sale and general approbation that they meet with, appear fully to justify the opinion entertained by the Committee of the utility of the machine as a family mill.

The whole apparatus is contained in a box fourteen inches square and eight inches high. And, in order to fit it for use, the mill should be fastened to a strong table, a cross-bar, a tree, a gun-carriage, or any other proper support which may happen to be at hand, by means of the four iron pins *dddd*, Fig. 1.

The sack is to be hung below the mill by means of three buttons or loops.

The grain being put into the hopper, the mill is brought into action by turning the winch, which is attached to the common axle of the machine from which all the other parts receive their motion. The farthest extremity of the axle is square, and fits into a corresponding hole occupying the centre of a toothed wheel, which latter turns another. On the axis of this last is fixed the feeder, consisting of an iron wheel, between two and three inches in diameter; the circumference of which has four notches or cells, for the purpose of receiving the corn, and conveying it in due proportion to the grinding plates. The larger toothed wheel has twenty cogs, and the smaller wheel has twenty-five, therefore five revolutions of the common axle occasion four revolutions of the larger wheel, and of course convey the amount of sixteen cells full of corn to the grinding plates. A small roller brush is placed between the hopper and the feeder, in order to prevent the feeder from becoming choaked.

Fig.

Fig. 1 is a back view of an iron bracket, to the other side of which the fixed grinding plate is attached; *d d d d*, are the iron pins already described; *q* is a round collar in the centre, through which the common axle passes; and *r* is a tube by which it is supplied with oil; *t t t* and *u u u* are screws which fix the grinding plate to the bracket, and at the same time adjust the former so as to make it truly vertical; *v* is a lip to prevent the grain, while passing to the grinding plates, from being forced behind them.

Fig. 2 is a section of the mill, passing between the two grinding plates, and showing the fixed one in its proper position; it is scored or channelled nearly in the same manner as common grinding stones,) *n* is a passage by which the grain passes from the feeder to the grinding plates; *z z* are two horizontal pillars which pass through the back of the wooden case in which the mill is contained, and are kept firm in their places by screw nuts.

In front of the mill is a strong cross bar, which supports one end of the common axle in the collar, and secures the ends of the horizontal pillars, by two more screw nuts.

The running grinding plate is fixed on the common axle by means of two nuts. Both grinding plates are channelled on their surfaces, as represented, Fig. 2, and being somewhat concave, the grain becomes continually more and more comminuted as it passes from the centre to the circumference of the plates, whence it falls through the slit F, into the sack suspended beneath.

The distance between the two grinding plates is determined by the regulator represented on a larger scale, Fig 3. It consists of a collar *a*, which slides backwards and forwards on the common axle, but is prevented by two projecting ribs working in two grooves from having

any

any concentric motion. That part of the surface of the collar adjacent to the screw nut *b*, is indented like a ratchet wheel, in order to receive the click. Hence the mode of its section is obvious. In proportion as the nut is screwed, so as to make the collar press against the cross bar, the running plate is brought nearer to, and at length into actual contact with the fixed one, while the contrary takes place by screwing the regulator in the opposite direction.

Fig. 1.

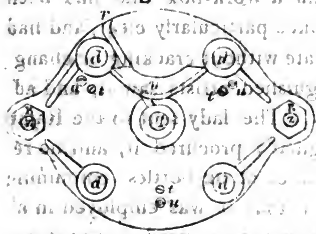


Fig. 3.

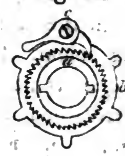
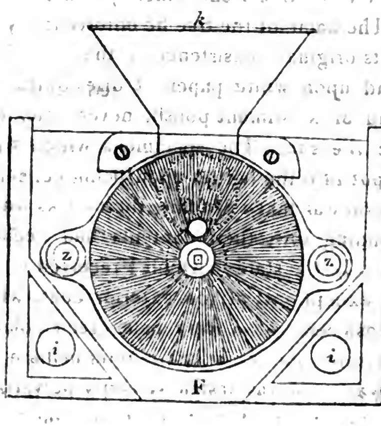


Fig. 2.



On a new Species of Resin from India.

By J. F. Daniell, *Esq. F. R. S. M. R. I.*

From the Journal of Science and the Arts,
Edited at the Royal Institution.

THE resinous substance, the properties of which I shall endeavour to describe, was sent to me for examination by my friend Mr. H. B. Ker. Its history is this: A lady brought from India a work-box that had been varnished: the varnish looked particularly clear, and had borne the heat of the climate without cracking or changing colour. Some distinguished artists saw it, and admired its peculiar beauty. The lady sent to the Rajah from whom she had originally procured it, and he remitted her an hamper full of stone bottles, containing the varnish, informing her that it was employed in all his ornamental work, and that it was used just as it was extracted from the tree from which it was procured, by incision. The name of the tree he unfortunately omitted to send. Its original consistence is that of cream, and when spread upon white paper, it dries quickly, is colourless, and of a brilliant polish, never cracking when exposed to the sun. The specimens which were sent over were put into the bottles upon being collected, and the precaution was taken of filling their necks with water. Notwithstanding this, their contents had become perfectly solid. In the state in which I received it the resin was opake, except just at the exterior coat, which was slightly translucent, of a very pale green colour, conchoidal fracture, and of a lustre intermediate between resin and wax. It was tasteless, easily pulverized, and inodorous. It inflamed with violence, and deposited much

much carbonaceous matter whilst burning, and diffused a pleasant aromatic smell. Its specific gravity was 1033.

Two hundred grains of it pulverized were boiled for three hours in half a pint of distilled water: it was then allowed to stand for twelve hours. The resin, on being collected and dried, had lost in weight only 0.8 of a grain. The infusion was reduced by evaporation, and it then presented the following properties. Muriate of tin threw down a dark brown powder; solution of chlorine in water produced a yellow precipitate; and muriate of alumina, when boiled with it, became cloudy. These are the indications of extractive matter.

It was then subjected to the action of cold alcohol. Much of it was dissolved, but an insoluble white powder remained, and did not decrease in quantity by boiling.

The same white substance was left when the resin was acted upon by ether and spirits of turpentine. It was collected upon a filter well washed with alcohol, dried at a gentle heat, and then weighed 75 grains.

The alcoholic solution was colourless, and had a very peculiar smell, resembling that of the bruised stalks of green vegetables: water instantly precipitated the resin. It was evaporated at a very gentle heat, and a light yellow transparent resin remained, which weighed 127 grains. The same resin was collected from the etherial solution.

The undissolved residue was inflammable, and burned with much smoke and a pleasant smell. It possessed no elasticity to the touch, but felt like powdered starch. It was not affected by any temperature under 360° of Fahrenheit's scale, when it began to fuse; and melted by a continuation of the heat into a deep-brown transparent resin. The resin which had been dissolved by alcohol began to soften at 100°, and the original resin at 220°.

The

The specific gravity of the most fusible was 932; of the least fusible 1000.

From these experiments it appeared probable, that the peculiar good properties of this resin, as a varnish, arose from the resistance of the latter ingredient to the action of heat and chemical menstrua, and that in nature the most fusible resin was the solvent of the least fusible. I was the more anxious to find out some means of again combining the two in the fluid state, as I had little doubt but that the compound might prove an useful acquisition to the arts.

Acetic acid acted upon the resin in the same way as spirits of wine, turpentine, and ether: it dissolved one portion, and left the other. Fifty grains of the natural resin and of the two separate resins were boiled in nitric acid. The action upon the most fusible was very violent. Nitrous gas was given off, and it was first converted into a deep orange-coloured substance, and then dissolved. The other two required longer digestion and a stronger acid, but were finally dissolved, after having been converted to a deep orange colour. Water added to the solutions produced a yellow precipitate, very bitter to the taste, and inflammable. Lime water produced no change, proving that no oxalic acid had been formed; but acetate of lead threw down a copious precipitate of malate of lead. It is remarkable, that the nitric solution, upon standing for some days, emitted a very strong smell of apples. It produced a slight cloud in solution of isinglass.

Solutions of the alkalies dissolved the most fusible resin copiously, the least fusible sparingly. They were precipitated by muriatic acid, and re-dissolved by excess.

Olive oil combined with the natural resin; but the compound was opake. When previously melted, it

 united

united with linseed oil, forming a drying varnish, but of a deep yellow colour. When subjected to distillation, a thick oil came over, possessing a strong empyreumatic odour. It was taken up by alcohol, from which it was again precipitated by the affusion of water. A small quantity of carbon was left in the retort.

From these experiments it appears, that the least fusible resin approaches in its characters to copal, differing, however, from it, in being insoluble in ether.

After many fruitless trials, I at length succeeded in effecting the solution of the resins, either combined or separate, by the following process. Equal parts of camphorated spirits of wine and oil of turpentine were put into a flask, and about an eighth part of ammonia added to them. The resin was then put in, in fine powder, and the whole boiled together. The turpentine does not unite with the spirits of wine; but from the agitation of boiling, they become intimately blended, and thus mixed, they act upon the resin and dissolve it completely. The addition of ammonia to either spirits of wine or turpentine separately, is not sufficient for this purpose. Upon being allowed to stand at rest for some time, the liquid separates into two portions. The lower is transparent and brown, the upper opake; but in the course of a few days likewise becomes clear, and is nearly devoid of colour. It has a slight tinge of green, and when spread upon white paper, it quickly dries, and forms a remarkably tough and glossy varnish. Its specific gravity shews that it is chiefly composed of the spirits of wine; it retains, however, a strong smell of the turpentine.

Very little of the resin is left in solution in the lower stratum of liquid, but nearly all the camphor; and when poured upon paper, it evaporates, leaving it behind in white powder, without any stain.

The

The mean of three analyses of the natural resin, one made by ether, and the other two by alcohol, gives the following result:

Extractive matter soluble in water	-	0.4
Resin soluble in alcohol and ether	-	62.6
Resin insoluble in alcohol and ether	-	37.0
		100.0

There can be little doubt but that if this resin can be obtained in sufficient quantity, that it may become a very valuable acquisition to the arts.

On the Probability of cultivating to Advantage the Marine Pea, and some other of the leguminous Class of Vegetables, on the Sea Shores of Great Britain and Ireland.

By JOHN SHERWEN, *M. D.*

From the LETTERS and PAPERS of the BATH and WEST of ENGLAND SOCIETY.

THERE is a fact recorded and established by the concurring testimony of so many of our ancient writers, as to leave not the smallest doubt respecting its authenticity; a fact, from which may be deduced inferences of great importance to the agricultural interests of the country. Viewing it in this light, I should think myself a negligent member of the Society, were I not to call its attention to the subject.

It is recorded in Stowe's Chronicle, that "In the moneth of August, (anno 1555,) in Suffolcke, at a place by the sea-side, all of hard stone and pibble, called in those parts a shelfe, lying between the townes of Orford and Aldborough, where never grew grasse, nor any earth was ever seene, there chanced in this barren place *sud-*

denly to spring up, without any tillage or sowing, great abundance of peason, wherof the poore gathered (as men judged) above an hundred quarters, yet remained some ripe, and some blossoming, as many as ever there were before; to the which place rode the Bishop of Norwich, the L. Willoughby, with others in great number, who found nothing but hard rocky stone the space of three yards under the rootes of those peason, which rootes were great and long, and very sweet," &c.

The same fact is mentioned by Sir R. Baker, in his Chronicle, page 346, ed. 1660. But we have a fuller and more particular account in the "Booke of Simples," written by an eminent physician and scholar, the learned Dr. William Bullein, whose description may possibly lead to a discovery of the exact species. His account is as follows: "Anno Salutis 1555, in a place called Orford, in Suffolcke, stones betweene the haven and the main sea, there did pease growe upon clusters, like the chattes or kaies of ashe trees, bigger than fitches, and lesse than the field peason, *very sweet to eat upon*, and served many poore people, dwelling there at hand; whiche els would have perished for hunger, the skace of bread that yere was so skal, in so muche that the plain poor people did make very much of akornes; and a sicknesse of a strong fever did sore molest the com'ons this yere, as none was ever hard of there. Now, whether thoccasion of these peason and providence of God cam through some shipwrake, with muche miserie, or els by *miracle*, I am not able to determine therof; but sowen by man's hand they were not, nor like other pease."

As far as I have had opportunities of examining, not one of the historians, by whom the fact is recorded, have dropped the slightest hint respecting the probability of turning this accidental discovery to the benefit of mankind.

kind. Even the enlightened mind of Camden was satisfied by merely stating the fact, and disproving its pretensions to miracle; nor did it make any other impression on that of the Right Reverend Bishop Gibson, his continuator. "When, in the year 1555, all the corn throughout England was blasted, the inhabitants tell you, that, in the beginning of autumn, there grew pease, *miraculously*, among the rocks, without any earth about them, and that they relieved the dearth in those parts. But the more thinking people affirm, that pulse cast upon the shore by shipwreck used to grow there now and then; and so the miracle is lost. But that such as these grew every year among the pebbles on the coast of Kent, we have observed before; [and a later writer saith, that at the south part of the Meer-shingle, there still come up yearly certain coarse grey pease, and very good coleworts, out of the stony heaps."]*

Ray, in his *Catalogus Plantarum Angliæ*, p. 244 and 5, has a long article on these peas, and considers them merely as an uncommon profusion of the English sea pea, the *pisum maritimum Britannicum* of Parkinson, or the *marinum* of Gerard. He says, they grow on other parts of the sea shore, in stony and sandy situations *in maris littore arenoso et saxoso*, viz. not far from the town of Hastings†. He tells us that the fact which I have quoted from Stow, was first related by Gesner in an epistle to Dr. Caius; and that the words of Gesner are, that the produce was so great as to supply even *thousands* of men, *vel millibus hominum*. Ray, like Camden, is satisfied with rejecting the miracle; and adds, that no-

* See Gibson's edition of Camden's Britannia, vol. I. p. 447.

† *Query*. Is the early pea, with which our markets are so well supplied in summer, under the name of Green Hastings, a cultivated variety of the sea pea?

body

body would willingly make use of them as food, unless urged by hunger and want of better aliment, *certe nisi urgente fame et in melioris alimenti inopia.* He totally rejects the opinion, that the abundant crop arose from seed scattered by tempests and shipwreck; and he, like every other relator of the fact, is silent respecting the obligation, imposed upon every friend to agriculture, of improving the hint, which may with the strictest propriety be deemed a providential one, although hitherto never acted upon.

I am well assured that the Society which I have now the honour to address, is too ardent in its pursuits, and too zealous in its endeavours for the benefit of mankind, to permit a fact so well substantiated, either to be passed over with indifference, as a mere matter of curiosity, or to remain any longer buried in the darkness of black-letter chronicles and books of physic. It is, indeed, impossible to reflect on this fact, which seems well authenticated, without deeming it highly probable, that there is *one at least* of the leguminous class of plants, the seeds of which will retain their vegetating property after frequent and long immersion and maceration in sea-water; and that they will not only vegetate under such circumstances, but thrive and produce abundance where, previous to this fortunate observation, no other esculent plant has been seen to grow, colewort excepted.

Doctor William Bullein was a professed botanical writer; he resided at that period in Suffolk; and it is evident that he must have been an eye-witness of the extraordinary vegetation, from his particular description. He says, they had roots two fathoms long, and were not like other peas. He, as a botanist, one would imagine, could not have been a stranger to the common maritime pea growing in his own neighbourhood. There is some reason,

son, therefore, to suspect that the species now under our consideration might not have been that alluded to by the conjectures of Camden and Ray, who never saw them. If they were of a different kind, the exact species can now only be brought to light by the aid of experiment; and I am persuaded that this Society will deem it advisable to substitute, instead of some which are now obsolete, a prize for the best conducted experiment, made with a view to discover if any of the other legumina, which we now possess, will vegetate in similar situations. I am sanguine enough to hope that *many of them* may be found possessing the like property; since it is well known that plants, nearly allied in botanical character, generally affect a similar mode of culture.

The experiment which I would recommend is plain and simple. Let a mixture of every known seed of the leguminous plants be scattered in situations resembling that at Orford or Aldborough; and it is possible that we may hereafter behold several of them taking root, and flourishing with the same vigour as the common sea pea. If the experiment totally fail, and we be compelled at last to admit the judgement of Ray to be correct, viz. that the astonishing crop of 1555 was really nothing more than a profusion of the English sea peas, why not adopt them as an article of cultivation? by means of which "*the unnumbered idle pebbles*" on our sea shores, where "never grasse grew, nor any earth was seen," and which have been hitherto consigned to perpetual sterility, may hereafter be clothed with verdure and vegetation, producing plenty of sustenance for sheep and oxen, if not immediately for man.

Whoever undertakes the experiment will doubtless recollect, that, on the testimony of Bishop Gibson, very good coleworts will grow out of the same stony heaps.

It

It would, therefore, be advisable to throw in the seeds of that plant at the same time.

If the experiment here suggested should succeed, it will probably occur to every member of this Society, that there are many acres of pebbles on the sides of our lakes and rivers in the interior parts of the country, in which, with still greater prospect of success, a similar cultivation may be attempted, so that flocks of sheep may hereafter be made, by the art and industry of man, to fatten almost upon heaps of stones.

Since this paper was drawn up, I find, in the first number of that suberb and valuable publication, the Continuation of the late Mr. Curtis's Flora Londinensis, the *pisum maritimum* elegantly and accurately described, and recommended to the notice of agriculturists. I sincerely hope the good intentions of the writer will be warmly seconded by the exertions and influence of the Bath and West of England Society for the promotion and improvement of Agriculture.

J. S.

P. S. The marine pea, being a perennial plant, maintains its situation wherever it obtains possession; and on this account, its cultivation becomes an object of still greater importance; for the extensive growth which either first took place, or was first noticed, in the year 1555, on the Sussex coast, still flourishes there, affording an annual supply of green nutritive food for sheep and oxen.

Account

Account of a new Pruning Instrument.

By Mr. William Menzies, *Gardener, Meikleour.*

From the Transactions of the Caledonian Horticultural Society.

I BEG leave to trouble you to lay before the Caledonian Horticultural Society, at the next meeting, the following account of an expeditious method of pruning larch, Scotch firs, and other pines. The sketch of an instrument by which that operation is performed is annexed.

To be the better understood, it will be necessary, first, to describe the instrument, which by the figure, (exactly half the real size,) will be seen to be simple, being merely two edged hooks, projecting from a socket-shank three inches in length, the breadth of which, where the hooks spring off, is two inches and two tenths of an inch; the hooks themselves project from the shank three inches; between them, and on the top, is placed a strong chisel four inches broad, and one inch in depth. It is needless to say, that the length of the wooden handle should be in proportion to the size of the trees to be pruned. Those used by us are of different lengths, from six to eighteen feet, which last is as long as a man can properly manage. Where trees require pruning to a greater height, a ladder was made use of for that purpose, with one of the short-handled instruments.

The hook is what we principally make use of, which cuts the branch from the upper side: the chisel is only employed when snags are left, and where branches are too strong for the hooks; in which case, the chisel is first made to strike the branch from below; but a mallet is never used.

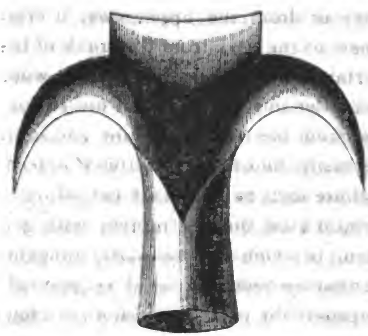
There is perhaps no instrument in use capable of pruning larch woods so expeditiously as this, particularly where they have been allowed to grow up close, and neglected for years, or where they have not been pruned at all. The branches of trees growing very open or in hedge-rows, are generally beyond its power, at least those near the bottom. In a larch wood at Meikelour Place, which had hitherto been neglected, two men were able, in the course of the day, when they worked only seven hours, to prune, on an average, 300 trees, on each of which there were from fifty to sixty branches cut off. Labourers wages here is 1s. 6d. per day, in winter; so the trees cost only 1s. per hundred pruning, and were pruned to the height of eighteen feet. That no time may be lost in shifting, there is a man to each instrument in use; the instruments being employed in rotation, according to the length of the handle, the shortest first, and so on.

Without a trial, some may suppose that, because the branch is cut from the upper side, it must necessarily tear off part of the bark from the trunk of the tree. This would certainly be the case with hard wood, were it to be pruned after this manner; but not so with firs, whose branches, from their brittle nature and horizontal direction, are easily removed; sometimes indeed they break, and snags are left, but these are cut off by the chisel.

I have also used this instrument with good effect and expedition, in removing unnatural branches from oak, and other hard-wooded trees. Fir-trees will certainly be much improved by pruning, both as to growth, and quality of their timber; but, in my opinion, care should be had not to over-prune them. Larches will always shew when that is the case with them, by breaking out into numerous unnatural branches; but it may not be so soon observed

observed in Scotch, spruce, or other firs, which, however, have generally a stunted appearance for some years afterwards, and sometimes it occasions their death. Four or five tiers of branches should always be left, particularly on young trees; and on larches there should be still more.

Few, I imagine, have as yet thought the pruning of firs an object worthy their attention. Perhaps the expence may, with some, be the only objection: by this mode, it is certainly very considerably lessened; for it must be remembered, that the trees instanced as being pruned for 1s. per hundred, were of a very large size. It is true, that trees, in the course of their growth to perfection, will require a great many prunings; but the oftener they are pruned, the less they will need at one time, and their value will be always increasing.



Remarks on French Pears.

By Colonel SPENS, *of Craigsanquhar.*

From the TRANSACTIONS of the CALEDONIAN HORTICULTURAL SOCIETY.

IN the finer and later kinds of pears, particularly the French, commonly cultivated in this Northern region, I think, that it may admit of a doubt, whether we have been guided by a thorough knowledge of the habits of the different sorts, or whether we have not rather been more influenced in our choice, by the goodness of the fruit itself, than by the sure bearing of the tree producing it, or by its being well adapted to our cold and variable climate. Aware that these kinds of trees often disappoint the hopes of the horticulturist, the Society have very properly offered a prize "for the best means of bringing into a bearing state full-grown fruit trees, (especially some of the finer sorts of French pears,) which, though apparently in a very healthy and luxuriant condition, are yet in a state of almost total barrenness." This, I think, has produced a very good paper from Mr. James Smith, Ormiston Hall, page 74, No. 1, of our Memoirs *. Yet I am inclined to believe, that to the several causes to which he has assigned our frequent want of success, a very strong one might be added, namely, the *shy bearing* of several of those sorts to be found in general in our gardens. Now, if I am correct in this idea, I apprehend, that no attempts which may be made, no pains or attention which may be bestowed, can, at least with respect to them, remedy the evil complained of. Bad management of many kinds, may render and keep a tree unpro-

* See Repertory, vol. XXVII. p. 294.

ductive,

ductive, which yet may again be made fruitful, by proper skill and better treatment. But what remedy can be applied to a tree naturally a shy-bearer? In my humble opinion none.

This leads me to suggest to the Society the expediency of calling for communications on the history and habits of the finer sorts of French pear trees usually cultivated in this country, founded on long experience gained in Scotland, in order to ascertain whether or not they be shy-bearers, and whether many of them may not require more sun to ripen their fruit than our seasons in most years will afford. Inquiry may also be made after other kinds more to be depended on; and besides offering prizes for new varieties to be raised from seed, attempts might be made to bring into notice any good late pears not generally known, fit either for the table or the kitchen, and to recover such kinds as may have formerly been successfully cultivated in any of the fruit districts in Scotland, but which are now apparently lost to us.

Accompanying this, is a list of some winter pears favourably mentioned by various authors, about which the Society may, if they think proper, inquire; some of them are French, others said to be Scotch. As far as I know, our number of Scotch winter pears is scanty indeed; and if three cannot be recovered, particularly recommended by Dr. Gibson, in his Fruit Gardener, and included in my list, I believe we have not above five more to depend on: which are the Swan Egg, Achan Brierbush, and John Monteath; and to them I am inclined to add the Muirfowl Egg, which, at least with me, keeps much longer than the Swan Egg, and at Craigsanquhar must be reckoned a winter pear, though, wherever I have seen it mentioned, it is set down as an autumn fruit. The Swan Egg has never kept good here beyond the end of November,

November, whereas the Muirfowl Egg has sometimes remained in good preservation till towards the end of April. This last season (1813) they were taken from the tree sooner than usual; therefore, were earlier ripe or fit to eat, and consequently have decayed sooner than ordinary. They were perfectly good till towards the end of January, 1814, after which they spoiled very suddenly. I may also, with great safety, allow the Muirfowl Egg to remain on the tree ten or twelve days longer than the Swan Egg: the leaves also of the latter fall much sooner than those of the former.

In a walled garden, many must be at a loss to know what kinds of trees to plant on the different aspects, so as to secure the probable chance of a fair crop, in tolerably favourable seasons. If application be made to the catalogues of nurserymen, who in their descriptions must of necessity be very concise, or if books on gardening be consulted, (the authors of which, I am afraid, often, without inquiry, copy from their predecessors,) they may be misled, or at least not get all the information necessary to enable them to make a judicious and prudent selection. For instance, they will find it mentioned, that the Cressane, the Colmar, the Boncretien, d'Hyver, the Chaumontelle, &c. are excellent pears, which is certainly very true; but they may not also be told, that some of them are shy-bearers, and that others of them, except in most favourable situations and seasons, do not ripen in this climate,—intelligence, which very probably would have led them to choose, or to inquire after other sorts, better suited to our Northern region.

In a garden possessing very great advantages, with respect both to soil and situation, the finer and later sorts of French pears may reasonably be attempted, or in one very extensive, much exceeding the usual size, the proprietor

prietor may indulge in them, because the great number of trees which he can command may make up for the scanty produce which each may yield to him. But in one of the common extent, and with no extraordinary advantages of soil and situation, it is of particular consequence to know, and to be contented with those kinds, which are ascertained to be generally productive.

If people are exposed to err from want of the necessary information to guide them in a selection of trees suited to the different aspects, and adapted to the climate, and, reasoning from my own experience, I must conclude many are misled, our Society might do an essential service, by calling for papers on this important subject, founded on the actual experience of years; and I think that it would be requisite that these communications should be requested from different districts, from regions high and low, that in general every one might obtain the information adapted to his particular situation.

I know that the Society is very sensible of the confusion and disappointment arising from different names being often given to the same fruit by different gardeners, and though the beautiful work which you inform me is now carrying on in London, the *Pomona Londinensis*, may, in a great measure, remedy this evil, and therefore, perhaps, supersede the necessity of our attempting any thing to the same extent, yet I humbly conceive that it might be advisable in our Society to publish a *Pomona Scotica*, with coloured plates, and that, either separately or periodically, in the different Numbers of our Memoirs as they come out. I cannot of course know what steps the composers of the London work may have taken to get a correct history of the Scotch fruits, yet I think that some of them will elude their search, or escape their notice.

P.S. *The*

P. S. *The following Winter Pears are favourably mentioned by various Authors.*

No.

1. Ambrette. French. Recommended as a great and sure bearer, by Switzer and Dr. Gibson.
2. Bessi de Quessoi, or Cassoi, or Little Winter Beurré. French. Mentioned by Mr. Miller and others, as a prodigious bearer.
3. St. Germain's. French. Very favourably spoken of by many authors; but it must be noticed, that there are at least two varieties of it. See a paper in the Transactions of the London Horticultural Society, p. 226, Part 5th, vol. I. See also Mr. Forsyth's List of Pears commonly propagated in England, No. 68, p. 89, of his book *.
4. Round Conical Pear. Scotch.
5. Round Winter Pear. do.
6. Oblong Round Winter Pear, do.

(4–6) Particularly mentioned by Dr. Gibson, in his Fruit Gardener, p. 334.

7. Pow Megg. Scotch, I suppose. No. 19 in the list of standard pears in Messrs. Machray and Gorrie's Account of the Orchards in the Carse of Gowrie, but whether for the table or the kitchen is not mentioned, nor is it described.
8. John Monteath. Scotch, I presume. A very fine Winter Pear, either for a standard or a wall, which it deserves.

* The true St. Germain is figured in the *Pomona Londinensis.*

On

On Lythography, and Observations on a Series of Lythographical Drawings, presented to the Academy of Fine Arts.

By M. ENGELMANN, *of Mülhouse, Upper Rhine.*

From the JOURNAL DE PHARMACIE.

THE commissioners employed by the Academy to make report upon the lythographical drawings by M. Engelmann, begin with this history of the art, and afterwards give a slight idea of its mode of execution. From the latter subject alone we intend making some extracts.

First, he lays down the principles on which this art is founded, and points out in what it differs from the methods of engraving.

The effects produced by a tracing or drawing on the stone with a greasy or resinous substance, are the simple results of affinities of which we have only yet remarked the influence.

There are three causes of these effects of affinities:

First, the facility with which this compact calcareous stone imbibes moisture, without its retaining it in too great a degree.

Secondly, the penetrating power or rather the strong adherence of greasy or resinous bodies to these stones.

Thirdly, the affinity of resins and grease for all bodies of the same nature, and the antipathy of these substances to water, and all moist bodies.

From these three principles arise the same number of consequences:

First, a stroke made with a pencil or greasy ink on the stone will adhere so strongly thereto, as to require some mechanical means to remove it.

Secondly, all parts of the stone, that are not covered by a coat of grease, will receive, absorb, and retain water.

Thirdly, if a layer of coloured greasy substance be passed over the stone thus prepared, it will only adhere to those lines formed by the greasy ink, whilst it will be rejected by those parts that are moistened with water only.

In a word, the lythographical process depends on these two points, that the stone saturated with water should resist the ink, and that this same stone, oiled or greased, should resist the water and take up the ink; thus by applying and pressing a sheet of paper on the stone, the greasy and resinous coloured lines will alone be transmitted on the paper, shewing a counter proof impression of that which is drawn on the stone.

For this purpose the stone must first be rendered capable of imbibing water, and at the same time of receiving with facility all greasy or resinous bodies.

The former object can be effected by an acid which will corrode the stone, and take off its fine polish and make it capable of receiving the water.

Any greasy substance is capable of giving impression upon stone, whether the lines be made with a pencil or with greasy ink, or otherwise the ground of a drawing may be covered with a black greasy mixture, leaving the lines in white.

Hence result two distinct processes:

First, the engraving by tracing, produced by the line of the pencil or brush dipped in the greasy ink.

Secondly, the engraving by dots or lines as is done on wood or copper.

It is easy to get impressions of prints without any reversing, by transposing on the stone a drawing traced on paper with the prepared ink.

From

From these observations we shall conclude that certain lythographical processes differ entirely from those of engravings; and as they partly depend on a play of affinities and repulsions, produced by substances of different natures, it is possible by varying them we may at length succeed in producing very unexpected effects.

The commissioners then notice the process made use of by M. Engelmann, and conclude by observing that they perceive in his works almost all the qualities belonging to an engraving, and likewise all those which belong only to original drawings.

Lythographic Process, or Method of Printing with Stone, invented in Germany.

All kinds of close calcareous stone of an even and fine grain, which are capable of taking a good polish with pumice-stone, and having the quality of absorbing water may be used for lythography.

These stones are found in many departments of France, and amongst other beds of calcareous stones, in the mountains which separate Ruffee from Argoulème; these are very proper for this kind of work.

Ink.

To compose the ink, heat a glazed earthen vessel over the fire; when it is hot introduce one part by weight of white Marseilles soap and as much mastic in grains; melt these ingredients and mix them carefully, then incorporate five parts by weight of shell lac, and continue to stir it; to mix the whole, drop in by degrees a solution of one part of caustic alkali in five times its bulk of water. Make this addition with caution, because if the ley is added all at once, the liquor would froth up and run over the edges of the vessel.

When the mixture of these substances is accomplished by a moderate heat and frequent stirring, a necessary quantity of lamp-black is to be added, and immediately after put in a sufficient quantity of water to make the ink liquid and proper for writing.

Drawing.

This ink is used to draw on the stone in the same manner as on paper either with a pen or pencil; when the drawing on the stone is quite dry and an impression is desired, the surface of the stone is wetted with a solution of nitric acid in the proportion of fifty to one of water; this must be done with a soft sponge, taking care not to make a friction on the drawing.

The wetting must be repeated as soon as the stone appears dry; it makes an effervescence, and when that ceases the stone is to be gently and carefully rinced with clean water.

Printing.

While the stone is still moist it should be passed over with the printer's ball charged with ink, which will only adhere to those parts which are not wetted. A sheet of paper properly prepared for printing is then spread on the stone, and the whole submitted to the press, or passed through a roller.

To preserve the drawing on the stone from dust, if not in immediate use, a solution of gum arabic is passed over it, which can be removed by a little water when the stone is wanted again.

Instead of ink they sometimes make use of chalk crayons for drawing upon the stone or upon paper, from which a counter proof is taken upon the stone. The crayons are made in the following manner:

Three

Three parts of soap, two parts of tallow, and one part of wax, are all dissolved together in an earthen vessel. When all is well mixed, a sufficient portion of lamp-black, called Frankfort black, to give it an intense colour; the mixture is poured into moulds, where it must remain till quite cold, when it will become consistent and proper to be used as chalk pencils.

Account of a new Method of ornamenting Japanned Metal Work by Efflorescence, resembling the Appearance produced by Frost upon Glass Windows, called Moiré Metalique, Metallic clouded Japan for Metals.

By M. Allard, Rue St. Lazare, Paris.

M. ALLARD has succeeded in giving the most brilliant and radiant efflorescence on metallic plates. This kind of Japan, the composition of which still remains a secret, produces the most brilliant and varied lights that can be imagined, called by the author moiré metallique, efflorescent japan; some of these are made to imitate the undulating lights in satin, or the reflected silvery tints of mother-of-pearl in such perfection, that one would suppose these plates had been prepared in the same manner practised in the East for making artificial pearls; others are made to imitate malachite or the silky copper ore of Siberia; in short the inventor has the power of representing on these metallic surfaces the appearance either of pearl, mica, or aventurine, and it must be confessed that no japanner in France has ever been able to produce such brilliant effects. This is a new art invented by M. Allard.

The plates made to imitate mother-of-pearl or malachite

chite make the most beautiful illusions. This clouded varnish is applied upon thin plates of tinned iron, which can be made into lamps, flower-stands, tea-caddies, &c. and can be furnished in plates of any size or form, to cabinet-makers and other artisans, so that it might become an elegant mode of ornamenting carriages, drawing-rooms, &c. &c. but it is impossible to have an idea of the beauty of these prepared surfaces without having seen them.

This efflorescence or frost work is produced by crystallisation operating by some new method on the surface of metal, and the figures or flowers of crystallisation vary according to the nature of the metal, and to the agents employed, also according to the degree of purity of each kind of metal. For instance, iron which has a particular crystallisation, presents a variety of crystallisations, whether applied upon cast-iron, soft-iron, tempered-iron, or upon steel, the flowers of the crystals produced on copper vary according to the proportions of alloy.

This process is in some degree a means of analysis, and on this account deserves the greatest attention; and as this invention is still in its infancy, M. Allard may hope still to make great improvements.

This mode of japanning is at present very expensive, but is not more than one-fourth above the price of the best japan work, yet it is to be expected that when it has gained sufficient repute, so as to be universally known and approved, M. Allard will possibly lower the price. The Society of Arts and Sciences at Paris have voted a gold medal to M. Allard, and the Minister of the Interior has granted him a patent for the invention gratis.

List

List of Patents for Inventions, &c.

(Continued from Page 128.)

JOHN NEILSON, of Linlithgow, Scotland, Glue Manufacturer; for an improvement in the tanning and tawing of hides and skins, and in the dying or colouring of leather and other articles. Dated June 22, 1818.

ALBERT ROUX, of Yverdon, in the Canton of Vaud, in Switzerland, Doctor in Divinity; for an improvement or improvements applicable to locks of different descriptions. Communicated to him by a foreigner residing abroad. Dated June 30, 1818.

JOHN BAIRD, of Lanark, Scotland, North Britain, Manager for the new Shots Iron Company; for various improvements in the manufacturing and making of cast-iron boilers, used for the purpose of evaporating the juice of the sugar-cane, or syrup derived from thence, by means of annealing them in a furnace or kiln of a peculiar construction. Dated July 11, 1818.

WILLIAM BAILEY, of High Holborn, Middlesex, Ironmonger; for certain improvements in sashes, sky-lights, and frames, generally used for the purpose of receiving, holding, and containing glass for the admission of light, and the exclusion of rain and snow; and also for making roofs or coverings for houses and various other buildings. Dated July 11, 1818.

JAMES MILTON, late of Paisley in North Britain, but now of Ashton-under-Line, Lancaster; for a new species of loom-work, whereby figures or flowers can be produced in a mode hitherto unknown upon any fabric of cloth, while in the process of weaving, whether such fabric be linen,

linen, cotton, woollen, silk, or any of them intermixed. Dated July 11, 1818.

JOHN RICHTER, of Holloway, Middlesex; for certain improvements in the apparatus or utensils used for distillation, evaporation, and condensation, and that the same are new in this country. Communicated to him by a foreigner residing abroad. Dated July 14, 1818.

RICHARD ORMROD, of Manchester, Lancashire, Ironfounder; for an improvement in the manufacturing of copper, or other metal cylinders or rollers for calico printing. Dated July 22, 1818.

URBANUS SARTORES, of Winchester-street, London, Merchant; for an improvement in the method of producing ignition in fire arms, by the condensation of atmospheric air. Dated July 22, 1818.

HENRY CREIGHTON, of the City of Glasgow, Civil Engineer; for a new method of regulating the admission of steam into pipes or other vessels used for the heating of buildings or other places. Dated July 22, 1818.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CXCVI. SECOND SERIES. Sept. 1818.

Specification of the Patent granted to Samuel Hall, *of Basford, Nottinghamshire, Cotton Spinner: for a certain Method of improving every Kind of Lace or Net, or any Description of manufactured Goods, whose Fabric is composed of Holes or Interstices made from Thread or Yarn, as usually manufactured, of every Description, whether fabricated from Flax, Cotton, Wool, Silk, or any other vegetable, animal, or other Substance whatsoever.* Dated November 3, 1817.

With a Plate.

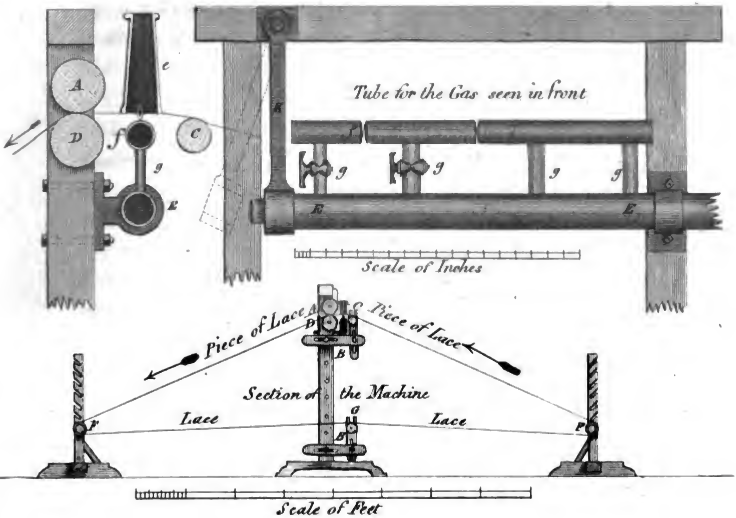
To all to whom these presents shall come, &c. Now know ye, that in fulfilment of the said proviso, I the said Samuel Hall have executed this instrument, by which I do declare, that my method of improving every kind of lace or net, or any description of manufactured goods, whose fabric is composed of holes or interstices made from thread or yarn, as usually manufactured, of every description, whether fabricated from flax, cotton, wool, silk, or any other vegetable, animal, or other substance whatsoever, is described and ascertained in the man-

manner following: The object of my invention is to remove from every kind of lace or net, or other goods of the description above-mentioned, all superfluous and loose fibres or ends of fibres, which are not so bound and twisted into the thread or yarn of which the lace or net, or such other goods, is composed, as to form a part of the solid body thereof; these superfluous fibres do not contribute to the strength of the thread or of the lace or net, or such other goods as aforesaid, but form a kind of fur or wool around the threads which make them appear thicker than they really are, and also fills up the meshes, holes, or interstices of the lace or net, or such other goods as aforesaid, and makes them appear indistinct and woolly. My method of improving lace or net, or such other goods as aforesaid is, by passing them through or at a very small distance over a body of flame or fire produced by the combustion of inflammable gas, while the said flame or the intense heat thereof is urged upwards, so as to pass through the holes or meshes of the lace or net, or such other goods as aforesaid, by means of a current of air, which is produced by a chimney fixed over the flame immediately above the lace or net, or such other goods as aforesaid. The action of the flame is to burn, singe, and destroy as much of the said superfluous fibres or fur, as may be removed without injury to the lace or net, or such other goods as aforesaid. A long piece of lace or net, or such other goods as aforesaid, or several pieces united together so as to form a large sheet, is made to pass between two rollers mounted one over the other like the rollers of a flatting mill; and the lace or net, or such other goods as aforesaid, are further to be extended over other rollers, so as to spread part of the lace or net, or such other goods as aforesaid, in an horizontal position; beneath this part the flame is applied, and the rollers being

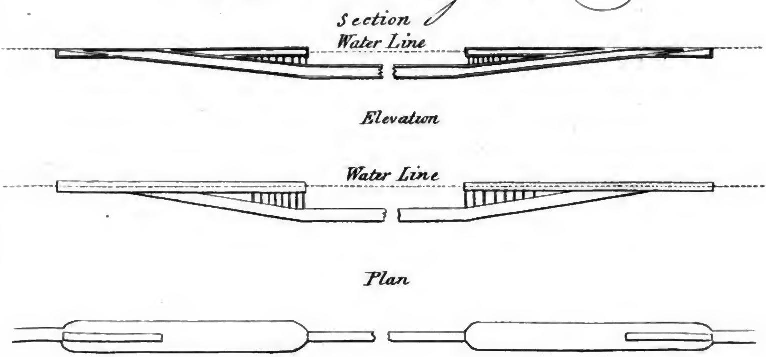
being turned round will cause the lace or net, or such other goods as aforesaid, to pass through or at a very small distance above the flame, so that every part of the piece shall in succession be subjected to the action thereof, and the velocity of the movement must be regulated, that the superfluous fibres of the lace or other goods as aforesaid will be acted upon in its passage through or over the flame, without having time to injure the lace itself. It must be obvious that the rapidity of the motion must depend upon the nature of the lace or net, or such other goods as aforesaid, and the intensity of the flame. It is of course impossible to give any general description of the motion that will be applicable to different cases; a slight trial, however, will be sufficient in each instance to ascertain and regulate the velocity, a regular and uniform motion will of course be most convenient and advantageous. The operation may be repeated as often as is found necessary to effect the required improvement of the lace or net, or such other goods as aforesaid; and the operation will be most readily effected if the two ends of the piece are united together, so as to form an endless band, which being extended over a system of rollers will circulate about the said rollers when they are turned round, and so every part of the said endless band will pass and repass continually through or over the flame. The apparatus for the production of the inflammable gas may be the same which is well known and in use for the purpose of illumination. The gas is to be conducted in pipes to the machine, and to enter into a tube which is placed horizontally beneath the lace or net, or such other goods as aforesaid; when the lace or net, or such other goods as aforesaid, have been sufficiently operated upon by the flame acting on one side, the piece is reversed, and the other side is subjected

to the action of the flame. The drawing hereunto annexed represents a system of rollers to operate upon lace or net, or such other goods as aforesaid, by the flame of the inflammable gas. AD (Plate VII.) are the two rollers, which may be covered with felt or other similar substance, and between which the lace passes; one of these rollers is put in motion by some mechanical force, or by a handle with a fly-wheel, to render the motion uniform; C is a roller to sustain the lace or net, or such other goods as aforesaid; E is a tube which conducts the gas; *g g* are little branches to conduct the gas to another smaller tube *ff*, which extends horizontally beneath the piece of lace or net, or such other goods as aforesaid, and in the upper side is a row of small holes to allow the gas to escape and form the flame; the holes are such distances asunder as to produce a continued flame of a length rather greater than the breadth of the piece of lace or net, or such other goods as aforesaid. In a wide machine the small tube *ff* should be divided into any convenient number of lengths, leaving as much space between each length as will allow for the expansion of the metal when the tube becomes heated. The upright branches *g g*, may be provided with cocks if required, and by means of which the supply of gas to any one of the said portions of the tube *ff* may be intercepted; if a narrow piece of lace is to be operated upon, *e* is the chimney to produce a current of air; F F are two rollers to extend the piece of lace or net, or other goods as aforesaid; these rollers are mounted in frames of wood placed on the ground, and made of sufficient weight to preserve the positions which are given to them: by this means the two rollers can be placed at such a distance from the rollers A D, as to extend the piece of lace or net, or such other goods as aforesaid, be the same longer or shorter; G is another roller

Mr. Hall's Patent



Mr. McCarthy's Patent



roller to support the piece of lace or net, or other goods as aforesaid, when it is very long; if the piece is short, the two rollers F F are not used, but the lace or net, or such other goods as aforesaid, is passed beneath the roller G, which is poised on centres in the supports B; these are attached to the uprights of the frame by bolts passing through slits, so that by regulating these the roller G can be placed in the most favourable position for extending the piece of lace or net, or such other goods as aforesaid. All the rollers must be made so that they can readily be moved from their bearings, in order to introduce the piece of lace or net, or such other goods as aforesaid, into the machine, after the ends thereof are joined together. The tube E is fixed to the frame at one of its ends, and the other end is supported by a piece of iron K, which is attached to the frame by a centre pin, and terminated with an eye or ring to receive the end of the tube; the iron K can be turned aside, as is shewn by the dotted lines, in order to detach it from the end of the tube when the lace is to be introduced or taken off, and then the tube will remain supported by one end only. The rollers are longer than the breadth of the piece of lace or net, or such other goods as aforesaid, or than the row of holes where the gas issues; and by this means the lace or net, or such other goods as aforesaid, can be put on the rollers, and they are put in motion before the lace or net, or such other goods as aforesaid, is brought over the flame; but when it is in full motion it is moved sideways on the rollers so as to come over the flame. A cock must be applied to the pipe E to regulate the gas, and whilst the lace or net, or such other goods as aforesaid, is put upon the rollers, this cock must be so far closed as to diminish the flame as much as possible without extinguishing the same; and when the lace

lace or net, or such other goods as aforesaid, is put in motion and fully extended over the flame, the cock is to be opened, and the flame will light up, so as to act upon the lace or net, or such other goods as aforesaid. During the operation of this machine, it is necessary to extend the edges of the piece of lace or net, or such other goods as aforesaid, before it passes upon the rollers C, to prevent folds or creases in the lace or net, or such other goods as aforesaid, which would interrupt the proper action of the flame. It will be proper to attach coarse lace or tape to the edges of the lace to keep them smooth and even; the edges are extended by one or two persons who stand between the roller F and the frame of the rollers A and D, and hold out the edges of the lace or net, or such other goods as aforesaid, with their fingers, without interrupting its motion. As the lace or net, or such other goods as aforesaid, will be somewhat discoloured by the operation, it may afterwards be bleached by any of the processes in common use. The operation is generally performed once before the goods are bleached, they are then half bleached, and the operation repeated; the bleaching is afterwards finished. The above apparatus or combination of machinery is conveniently adapted for the purposes of the said invention; but I do not claim the exclusive use of my apparatus or combination of machinery, except in connection with and in aid of the application of the flame of inflammable gas, to the purposes above described in this specification.

In witness whereof, &c.

Specification

Specification of the Patent granted to John James Alexander M'Carthy, *of Milbank-street, in the Parish of Saint Margaret, Westminster, in the County of Middlesex, Gentleman; for an Invention of a Road, or Way, or Passage across Rivers, Creeks, and Waters, and from Shore to Shore thereof, without Stoppage or Impediment to the constant Navigation thereof, and across Rivers, Fissures, Cliffs, and Chasms; and of a new Method or Methods of constructing Arches or Apertures for the running and flowing of Water through the same, or under Bridges, to be used and applied in the Construction of the before-mentioned Road or Way and otherwise.*

Dated August 26, 1814.

With an Engraving.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said John James Alexander M'Carthy do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed, by the plan or drawing in the margin of these presents, (see Plate VII.) and the following description thereof; that is to say: My invention is of a passage suspended in a river or in other water, and to rise and sink therein, so that such passage shall remain at a distance from the surface of the water, sufficient to allow a ship or ships, or other vessels to pass over and above the said passage; and in order that the said passage may be buoyant, the ends of the same are formed so as to make an inclined plane from such parts of the passage over which ships and vessels may pass; and, so as the exits or entrances of such passage project above the surface of the water. The said inclined

inclined planes continue the said passage, and connect the same with a floating bridge made in the usual manner, the whole to be moved both above and below. The said passage may be formed in the shape of a cylinder or any other more convenient for the purpose, bent at each end to form the inclined planes, and may be made of iron or other materials. The said passage is gravelled, or may be paved as other roads; care must be taken to make the passage of such weight and substance, as that it will sink under the surface of the water to the required depth, and that the inclination of the plane be such as to allow carriages to pass up and down the same with safety and facility. The ends of the inclined planes are to be sufficiently defended against injury from ships or vessels, or other external causes. The said passage must be placed in such part of the water, and must be so connected with the said floating-bridge, as will be most suitable for the navigation. The parts of the bridge leading from the two shores to the said passage are formed in the usual way.

In witness whereof, &c.

Specification of the Patent granted to HUGH RONALDS, *of Hammersmith, in the County of Middlesex, Gentleman; for certain Improvements in the Art of making Leather.* Dated January 23, 1818.

With an Engraving.

TO all to whom these presents shall come, &c, NOW KNOW YE, that in compliance with the said proviso, I the said Hugh Ronalds do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described

scribed and ascertained in and by the drawings hereunto annexed, and the following description thereof; that is to say: Presuming that the common method of making leather is known, I shall describe the mode first of making my tanning liquor; and, secondly, of making leather with the liquor so obtained.

C D, (Plate VIII.) represents a plant of taps or vats for making the liquor numbered 1, 2, 3, &c. to 16, divided from each other by strong boards, each tap or vat having a false bottom, and an eye or pipe, so constructed that the bottom of every tap or vat may, by means of a cross pipe leading from the eye or pipe, communicate with the next tap at ten inches, or any more convenient distance from the top. *a a a*, are small pipes, furnished with the cocks leading from the eye or pipe of each tap into the main pipe K L, which is fixed about ten inches, or any more convenient distance, below the top of the taps. The eye of the tap, No. 9, is connected with the tap 8 by means of the pipe *b* running under the main pipe K L and the eye of No. 1, connected with No. 16 in the same manner. By means of the above-mentioned communications between the bottom of one tap and the top of the next tap, the liquor will find its level throughout the whole range of taps, or may be stopped by a plug in the cross pipe. The tap or vat 16 contains the weakest liquor and tan. 15 contains tan and liquor one degree stronger, and so on each tap, growing progressively stronger to 1, which contains the strongest liquor and fresh bark. E F represents a plant of hide pits, numbered from 1 to 20; the tops of which are about two feet, or any more convenient distance, below the tops of the taps, constructed in the same manner as the taps are, except their not having false bottoms. The main pipe *m n* resembling the main pipe K L, and small pipes *c c c* resembling the small

pipes *a a a*, and the same communications between the adjoining pits as were before described between the taps. A is a copper or reservoir to contain water; the bottom of which will command the top of the taps. B is a reservoir, upon the same level as the copper A. G is a receiver, or large pit, commanded by the pipe *m n*. H is a pump to raise the liquor into the reservoir B from G. I is a waste pit or drain from the exhausted liquor. *o o o* represent moveable shoots, by which water or liquor may be conveyed from one place to another.

Having described the construction of the taps and pits, I now proceed to the method of working them. Oak bark, or any substance containing the tanning principle, is put into the different taps: and into the first or weakest of the taps 16, water is introduced by means of the pipe from the reservoir A. A communication being open from the tap 16 to 15, and from 15 to 14, and so on to 1, it is evident that 16 will contain the weakest liquor or infusion; and that this will become progressively stronger till at 1 it becomes of sufficient strength for use in the pits. By means of a shoot *o o* the liquor passes from tap 1 to the pit 1 in the plant of hide pits E F: which pit contains hides that are in the most forward state from the bottom of the pit 1. The liquor being partly exhausted by the hides in No. 1, runs through the eye and cross pipe, mentioned above, to the pit 2: in the same manner the liquor runs through each adjoining, exhausted by the hides in each, till it arrives at 20, when, if quite exhausted, it runs to waste, and if not exhausted, runs into the receiver G, to be pumped into reservoir B, whence it is thrown upon the tap, as before described. The liquor being the strongest when it first arrives from the taps, it is evident the further it is conveyed through the pits the weaker it becomes; the hides are therefore in a less forward state as the li-

quor

quor proceeds. When the tap 1 is full of bark, the communication between 16 and 15 must be stopped. 16 may be emptied, and the communication between 1 and 16 must be opened: fresh bark being thrown into 16 it becomes the strongest tap, and 15 becomes the weakest. When 16 becomes full of bark, the same operation proceeds; 15 is made the strongest, and 14 becomes the weakest, by the same means, and so on all round, so that every time a tap is filled with bark that which was before the weakest is made the strongest, and that which was the weakest but one becomes the weakest, and thus each tap in turn becomes the weakest and strongest: no other labour is required in making the infusion than that of employing the worst tap as the best becomes full; the hide pits are changed in the same manner. Suppose 20, in the plant E F, to contain the greenest hides, suspended on poles, and the liquor proportionally weak; No. 19 is filled with hides and liquor one degree forwarder, 18 still one forwarder, and so on each pit, increasing progressively in the strength of the liquor and in the forwardness of the hides to No. 1, which contains the strongest liquor and forwardest hides.

By describing the work of one day the whole process may be explained, and I shall suppose the yard to be in full work. In the plant of taps C D let all the small pipes leading from the respective eyes into the common pipe K L be stopped, except that at No. 1, which is to be left open, the communication between 1 and 16 being stopped by a plug or cock in the cross pipe; and let a shoot be placed so as to convey liquor from the end of the pipe K L to the top of the pit 1, in the plant E F. Let all the small pipes *c c c*, leading from the respective eyes into the pipes *m n*, be stopped, except that at 20, which is to be left open. The communication between 1 and 20 being

 stopped,

stopped, let a shoot be placed at the end of the pipe *m n*, so as to convey liquor into the waste pit I. Now let water run gently from the copper or cistern upon the tap 16. The liquor in 16 will rise through the eye and cross pipe to its level in 15, this again to its level in 14, and so on till the strong liquor in 1 will run through the small pipe *a* into the pipe K L, thence it will run by the shoot *oo* upon the pit 1, plant E F, containing the forwardest hides. The same operation will go on here as in the taps: the liquor in No. 1 will find its level in No. 2, that to its level in No. 3, and so on, changing its liquor in every pit till the liquor in No. 20, supposed to be quite exhausted, will run off the green hides into the pipe *m n*, and thence to waste; but in case the liquor is not quite exhausted, it may be necessary to keep three or four pits, at the end, for the purpose of spending the liquor by green hides. When the hides in pit 1 are sufficiently tanned they are taken out, and the communication between 1 and 2 being stopped, the liquor is pumped out of No. 1 upon No. 2; No. 1 is cleaned out; the communication with No. 20 is opened; the weakest liquor will, therefore, run from No. 20 upon No. 1, which will now be ready for the reception of green hides. The same operations are performed when the hides are tanned and taken out of No. 2. No. 3 then becomes the forwardest, and No. 2 is prepared for the reception of green hides, and this takes place throughout every pit.

The process of tanning, described above, will be accelerated by having the pits and taps inclosed, and keeping up the temperature above 60 degrees of Fahrenheit, by any of the well-known methods of applying heat. The leather is well filled in the early stages of its progress, and very equable in its texture, and is firm and heavy. By this process I have tanned leather in a much shorter time, and

and of a superior quality, than in the common mode of tanning.

I maintain that the opening a communication between all my hide pits in the manner above described is perfectly new; and that my invention chiefly consists in keeping up a constant flow of the tanning liquor through the pits upon the hides.

In witness whereof, &c.

On the great Strength given to Ships of War by the Application of Diagonal Braces.

By ROBERT SEPPINGS, *Esq. F. R. S.*

With an Engraving.

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

SINCE the time that I first suggested the principle of applying a diagonal frame-work to ships of war, which was first partially and successfully adopted in the Kent, a seventy-four gun ship, in the year 1805, my mind has been continually and anxiously turned to this important subject; and it was not until the utility of the experiment had been fully established in the opinion of most naval officers, that I ventured to present to the Royal Society, a paper on the application of this well known principle to the construction of large ships of war, but which, as far as my knowledge extends, never had before that time been so applied, either theoretically or practically, in this, or any other maritime country; and I am well assured, that no such application, or suggestion, appears in any of the Continental writers on naval architecture. I merely mention this, because it has been pretty broadly insinuated that the idea was borrowed from

from the French. The propriety of a different disposition of the materials entering into the construction of a ship, has at different times, for more than a century past, been suggested by English ship-builders; and partial alterations have, in consequence, been introduced; but no one, that I am aware of, has at any time proposed the system of a diagonal trussed frame. If I have received any assistance in the progress of this new system, now universally adopted in the British navy, it was from the plans and drawings of the celebrated bridge of Schaffhausen, and from no other source.

The extensive application of this principle to no less than thirty-eight sail of the line, and thirty frigates, might perhaps be conclusive as to the advantages expected to be derived from the new system; but as the Royal Society did me the honour to introduce my account of that system into their Transactions, at an early period of its adoption, I am led to hope that the result of a practical experiment, made with a view of proving the correctness of the principle, may not be deemed an improper or an uninteresting corollary to my former paper.

In the early part of this year (1817) the Justitia, an old Danish seventy-four gun ship, was ordered to be broken up on account of her defective state; and having observed her to be considerably arched, or hogged, as it is usually termed, I determined, notwithstanding her age and defective state, to apply the trussing principle to a certain extent, with a view to observe what effeet it would produce on a fabric reduced to so weak and shaken a condition.

The officers of the yard were directed to place sights on the lower and upper gun-decks, prior to her being taken into the dock; and to ascertain, when she grounded on the blocks, how much she had altered from the state in

in which she was when afloat. They were then to place a certain number of trusses (conformably with the annexed drawing, Plate IX. Fig. 1.) in the following manner: those in the hold marked A, to be placed in an angle of 45°, or thereabouts, and those marked B, at right angles to them; those in the ports marked C to be placed from the midships forward, in an angle of about 40°, and, from the midships aft, at the same angle, but in an opposite direction. As it was uncertain where the centre of fracture (or point of separation) would take place, a few of the port-holes about the centre of the ship were crossed, as shown in Plate IX. at D. Wedges were applied to the heels of the trusses, which were then set tight. The ship being thus partially trussed, the water was then to be let into the dock, and the ship floated out of it into the bason, where she was to lay one hour, when a committee was to examine the sights, and ascertain how much the ship had altered; and again, what change had taken place in twenty-four hours after floating. This being done, the trusses were to be disengaged in as short a time as possible, in order to observe whether the effect of their removal would be instantaneous, or gradual.

The following is an extract of the report of the committee:

"When the ship was in dock, on blocks perfectly straight, she came down in the midships, by the sights placed on the gun-deck, two feet two inches and a half; and by those on the upper deck, two feet three inches and a quarter; and when undocked, with the trusses complete, and in their places, she hogged, or broke her sheer, by the sights on the gun-deck, one foot two inches; and by those on the upper deck, one foot two inches and five-eighths; and at the expiration of twenty-four hours she had hogged or further broke her sheer two inches

inches and five-eighths, and then appeared stationary, and completely borne by the trusses.

"We then proceeded to take away the trusses in the hold, and when they were wholly disengaged, she further hogged, or broke her sheer, six inches. We next proceeded to take away the trusses in the ports, and when they were wholly cleared, she dropped at the extremities, (or further hogged) three inches and a half, and was in the same position when tried twenty-four hours after.

"We further beg leave to state, that the whole of the trusses marked B, slackened as the ship floated from the blocks, and became short from half an inch to three inches and a half, and partook of no part of the pressure; which in our opinion clearly proves that the direction in which Mr. Seppings has applied his diagonal frame is correct, as also the great utility of the trussing system; for although this ship, from her very defective state, was much against so severe an experiment, it has proved to us its good effects most satisfactorily; for many of the trusses in the ports forced *the timbers* three-eighths of an inch within the ends of their covering planks, thereby lessening their effect from what it would have been if the ship had been of a sounder texture; yet on a ship in this state, the trussing between the ports alone, after those in the hold were wholly disengaged, had the effect of sustaining the immense pressure of both ends of the ship in her worst position, and prevented her from breaking, which she otherwise would have done, from three to four inches, and which she actually and *immediately* did on their being disengaged."

This statement of the Portsmouth officers, I trust, will be considered conclusive as to the benefits to be derived from the principle of trussing in the construction of ships; and although it was only applied from the keelson

to

to the beams in the hold, and not to the ribs or frame of the ship, as is the case when ships are regularly built on this system, yet it sufficiently establishes the soundness of the principle.

When the Justitia first floated, after being partially trussed as described, the noise occasioned by the pressure on the trusses is stated to have been "truly terrific," until she was fairly settled on them. The disengaging them also caused a similar crash.

As, previous to the abovementioned trial on the Justitia, some professional persons had expressed a doubt, whether the braces ought not to have been placed in the direction of the trusses, and *vice versâ;* the following experiment was exhibited to show what was expected to take place, and which did actually take place on the trial made upon the ship.

Let Fig. 2, Plate IX. represent a frame of wood, having the braces B pinned to the upper and lower ties C; let the trusses D and the longitudinal pieces E, be merely let in without any fastenings; then make the point F the fulcrum, and pressing down the ends G G, it will be found that the frame comes more in contact by the pressure. Next reverse the frame, and let H become the fulcrum, and by pressing at I, I, it will be seen that the trusses D and the longitudinal pieces E will immediately be disengaged and fall out; this proves that, had the long braces in the ships built on this system in the diagonal frame, been placed in the same direction that those in this experiment were that are marked A, the ships so constructed would, in the act of launching, pitching in a sea, and as they grew old, have slackened certain parts of the diagonal frame, and the fabric would have been supported by long *crooked trusses,* whose ends would have had but one point of support, namely, the shelf piece or

internal hoop; and what is more objectionable, the ends of the trusses would, if so placed, have been cut off to an angle of 45°. On the contrary, by making the ties in the diagonal frame the abutments, as many additional points of support are gained, as the trusses B exceed the braces A; and further, the trusses B are now straight and short, and their ends are cut off to a right angle, and thereby give a support, and the longitudinal pieces a fixedness, which would not have been the case had they been laid in the other direction.

Indeed no stronger proof could be adduced in favour of the efficacy of the principle, than that which was furnished in the launching of three ships of 120 guns (the Nelson, the St. Vincent, and the Howe). In form and dimensions these three ships are precisely the same, and their frames, beams, and external planking, of the same scantlings: the two former were built according to the old plan, and the latter upon the diagonal system. After the Nelson was launched, she was found to have altered nine inches and a half from her original sheer, and the St. Vincent nine inches and a quarter, while the Howe altered only three inches and five-eighths. The whole machine in the case of the two former ships was generally disturbed: the Howe exhibited no such symptoms.

I shall only further state, that after the memorable battle of Algiers, I requested the Navy Board to call upon Captain Coode, of His Majesty's ship the Albion, to report on the state of that ship, she being built on the new principle; and the following is an extract of his letter to them:

"I beg to inform you, that it is the opinion of myself and the officers of the Albion, that it was impossible any ship could have stood the concussion from firing, and the recoil of the guns, better than she did; and on a very minute

minute inspection of the ship after the action, there was not the least difference to be observed, except what had been made by the enemy, between the side of the ship that all the firing was from, and the side that not a single gun was fired from during the action; and every bolt and knee was as perfect and secure as before the action commenced, which was also the case of the lower and main gun-decks, but the quarter-deck was staved in several places; which in my opinion would not have been the case, had it been on the same construction as the decks that stood so well."

The Albion's decks, so well spoken of by Captain Coode, are laid diagonally; the quarter deck as usual, fore and aft.

To submit the diagonal decks to the test of experiment, I caused the decks of the Northumberland, of 80 guns, to be laid on one side fore and aft, as is usual, and on the other side diagonally, conformably with my principle; the materials on each side were of the same description, and the beams attached to both sides of the ship by the same mode.

This ship was ordered to convey General Buonaparte to St. Helena, and Rear Admiral Sir George Cockburn was, by the Lords Commissioners of the Admiralty, directed to report on the comparative merits of the decks. The following is an extract of a letter from Captain Ross of the Northumberland, to Sir George Cockburn, which was transmitted to the Admiralty:

"I have to state, that the fore and aft side required caulking on the passage from England (which was partially done) when the diagonal side did not; the fore and aft side now requires caulking all over, and the diagonal side very little; being, in my opinion, and that of the carpenter, much in favour of the diagonal decks."

On the return of the Northumberland to Sheerness, the officers of the yard were directed very particularly to survey her decks. After speaking of the favourable report made to their enquiries by the officers of the ship, they stated as follows:

"This report of the officers was confirmed by the general appearance of the ship on her arrival at this port, and having subsequently caulked and minutely examined the state of the decks and water-ways, we find the comparison so much in favour of the larboard side, as to determine, that the diagonal system of laying decks is preferable to the common system."

Description of a Machine for cleaning Corn.

By Mr. C. Essex, *of East Acton, Middlesex.*

With an Engraving.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The Gold Ceres Medal was voted to Mr. C. Essex *for this Communication.*

THE machine for cleaning corn is peculiarly adapted to use under a thrashing machine, as by one process, with the same power necessary for the thrashing machine, it completely cleans the corn, and renders it fit for market; at the same time dividing the different substances into the several compartments, with the power (by altering the sieves) of making two sorts of corn (by cleaning both), or, in other words, by taking away as much of the small corn or tailing, as may be required, thereby rendering a samp.e superior in quality.

Having

Having used the machine nearly eighteen months, I beg to remark, that from its peculiar power of dividing the dust from the chaff, I find the latter much more nutritious for cattle; and the superior mode of clearing the rubbish, that the corn may fall to the wind alone, renders it much more susceptible of the quick succession of friction, which completely eradicates every particle of mould, and, in a degree, has the effect of drying and improving the sample; and which, as in the last wet season, renders it peculiarly useful; added to these, are many other advantages which will suggest themselves to those acquainted with the necessity of such convenience and expedition in agricultural pursuits.

CERTIFICATES *addressed to Mr.* ESSEX.

Having seen your newly-invented machine work, I with pleasure give it my entire approbation, and sincerely congratulate you on your success. It is far superior to any I have ever seen, inasmuch as it saves much trouble and expense in the necessary division of racquet, chaff-dust, hulks and corn, which it divides in a very complete manner, rendering the corn perfectly clean and fit for market. I think the division of the dust and small seed weeds from the chaff a great improvement, as, when the chaff is carried into the stable, the carter generally sifts the seed weeds in the dung, which of course is carried again to the field.

East Acton, Feb. 17, 1817. R. BAGSHAW.

I have carefully examined the machine which you have invented for clearing corn, and I approve of it entirely for these reasons: First, it separates the chaff and rubbish from the corn at once, so that the latter is quite clean

clean and fit for market immediately, which, for several reasons, must be of great advantage to the farmer. Secondly, the chaff is separated also from the dust, and therefore is better for cattle. Thirdly, the seeds of weeds being also, with the dust, thrown apart from the chaff, can be destroyed, so as not to go to the dunghill and be carried to the field again. Fourthly, the corn passing so rapidly through the several sieves must be much dried and cleared from mould ;—a great benefit, in my opinion as a mealman, especially in seasons like the present. And, fifthly, to these advantages I may add, that *all* is effected by one and the same, and no greater power than that which at the same time puts the thrashing machine in motion.

Acton Mill, Feb. 18, 1817. J. ADAMS.

In answer to your's of Tuesday last, requesting my opinion of your newly-invented cleaning machine, I have great pleasure in stating that, to my judgment, it fully answers the purposes intended, particularly that of cleaning the corn, and at the same time completely separating the chaff from the dust, which, of course, renders it in a much better state for cattle. I must at the same time observe, that I consider it a great acquisition attached to the thrashing machine, in completing the whole of the business, which before was no more than half done, and that in great confusion.

Acton, Feb. 19, 1817. C. FRISBY.

I beg leave to express my entire approbation of your newly-invented machine, which I saw at work the other day. In my opinion it claims the superiority over every other machine I ever met with, by the facility with which it

it clears away the different substances, such as racquet, hulk, and chaff, and stops the dust: by these means the corn is presented to the wind in the same state as when it has passed twice through other machines, and is by one process cleaned and rendered fit for the market. It has also the power of making two samples, which, by altering the sieves both at the same time, and preventing the dust from being blown with the chaff, renders the latter more nutritious for horses; and the small seeds remaining with the dust, prevents them from being carried into the field again. I beg to remark, that by the quick succession of friction the grain undergoes, it not only rubs off any dust or mould, but dries it and renders the sample much brighter; besides, the advantage must be great, arising from the convenience, expedition, &c. by which every part of the process is attended.

Harlesden Green, Wilsden, ROBERT TUBBS.
Feb. 19, 1817.

Having been present at the working of your improved cleaning machine, I have much pleasure in saying, that I am perfectly satisfied as to the complete manner in which it delivers the corn at once clean and fit for market; also, that great merit is due, as it separates the chaff from dust and seeds of weeds, which certainly is a great acquisition.

East Acton, Feb. 20, 1817. THOMAS YOUNG.

REFERENCE TO THE ENGRAVING.

A A, (Plate IX.) Figs. 1, 2, and 3, the hopper into which the corn is poured, as it comes from the thrashing mill.

B,

B, Fig. 1, a sliding board by which the size of the aperture, through which the contents of the hopper are discharged, is regulated.

C, Fig. 1, the sieve-box in its place.

The sieve-box is suspended by four chains, two on each side, *a a;* these are attached to rollers with ratchet wheels D D, Figs. 1 and 2, by means of which the chains may be lengthened or shortened at pleasure, and consequently a greater or less slope may be given to the sieve-box and its contents.

E, Figs. 2 and 3, a cog wheel turned by means of a handle, and working into two pinions, one at top and one at bottom; of these, the former F, Figs. 2 and 3, has its axis lengthened into a crank G, Figs. 1 and 3, by means of which a reciprocating motion is communicated to the sieve-box.

b c, Fig. 1, the wing of the sieve-box, consisting of a sloping board, which forms the bottom of the hopper, and into which are inserted three pegs, in order to prevent the racquet from collecting in the hopper.

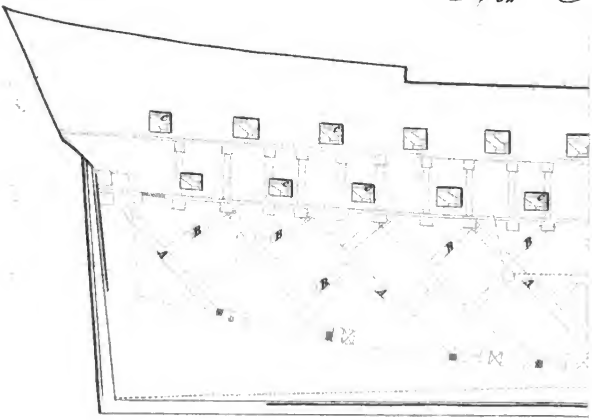
c d, Fig. 1, the back of the sieve-box, to which are attached the hinges of the sieves.

e e, Fig. 4, bolts by which the sieves are supported in front, by being pushed into holes in the sides of the sieve-box; to each sieve are four or five pairs of holes, which thus admit of considerable variety in the degree of its slope. This figure shews the front of a sieve, with the bolts on a large scale.

f, Fig. 1, the upper sieve made of split willow wands, by which the racquet is separated from the corn and other substances. The corn, &c. falls through the meshes of the sieve, and the racquet sliding over the front is received in the wooden spout H, Figs. 1 and 2, which conveys it out of the machine.

g,

Mr S



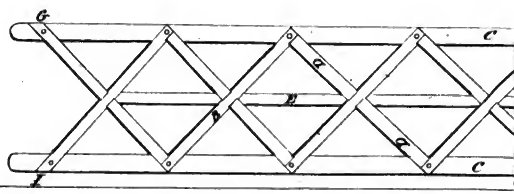
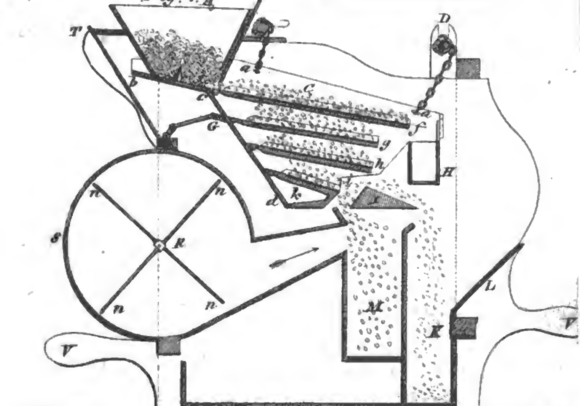


Fig. 4.

Fig. 1. A



g, Fig. 1, the second sieve of wire, which detains the chaff and hulks, and allows the dust, small weed-seeds, and corn to pass through; the hulks and chaff fall over the front of the sieve upon the inclined plane, I, Fig. 1, and thence into the receptacle K, Fig. 1; and, as they are falling, are exposed to the blast from the fan, by which they are cleaned, from the dust and thus rendered better food for horses: the contents of this receptacle are taken out by drawing the sliding board L, Fig. 1.

h, Fig. 1, a wire sieve (the 3d), the meshes of which are closer than the preceding, in order to detain such hulks as pass through the form. These fall over the front of this sieve upon the inclined plane just mentioned, and so into the receptacle K.

The lowest sieve *i*, Fig. 1, has its meshes so close, as only to allow the dust together with the weed-seeds and small corn to pass through; the full-grown corn rolls along its surface, and falls over in front upon an inclined plane, by which the grains are dispersed, and thus are exposed to the blast from the fan, which carries off the light impurities. The corn being now thoroughly cleaned, falls into the box M, Fig. 1, where it remains free from dust.

The dust, &c. that passes through the lower sieve, falls into the receptacle *k*, Fig. 1, and is discharged from the machine by the spout O, Fig. 2; it then falls on the sieve or screen P, Fig. 2, which by means of the foot *l*, and the notches *m*, may be set to any required slope, and thus will separate the small corn from the dust and weed-seeds.

The cog-wheel E, Fig. 3, already described, turns the pinion Q, the axis of which prolonged, forms the spindle R, Fig. 1, to which the fliers *n n n n*, Fig. 1, of the fan are attached.

S, Figs. 1, 2, and 3, the cover or hood of the fan, fastened by hooks and staples, and therefore capable of being removed at pleasure.

T, Fig. 1, a sliding board, allowing access to the crank for the purpose of greasing or repairing it.

The racquet spout is suspended by hooks below the sieve *f*.

V V, Figs. 1 and 2, handles of the machine.

On Air and its Properties relative to Respiration.

By the Marquis de CHABANNES.

Extracted from his Work on conducting Air by forced Ventilation, and regulating the Temperature in Dwellings, &c. &c.

THE air of our atmosphere is composed of oxygen, nitrogen or azote, and a little carbonic acid. The oxygen, in breathing, is absorbed by the lungs, and is so essential to life, that in air deprived of it, all animals instantly perish. It has hence been called vital air. In air, containing less than the natural proportion of oxygen, although an animal does not die, its vigour is immediately impaired, and if the privation be long continued, disease and death are the certain consequences.

An animal, in breathing, not only vitiates the air about it by abstracting the oxygen, but also by loading it with noxious effluvia from the lungs and skin: the existence of which is familiarly proved in the case of the dog, which by the nose alone can follow his master.

We have thus an explanation of the dreadful consequences which have been experienced from breathing air in situations either altogether confined, or ill ventilated; as

as the suffocation in the Black Hole at Calcutta, the fevers and other diseases of prisons, hospitals, ships, &c., the head-ache and distress which so many suffer in crowded theatres, ball-rooms, small bed-rooms, &c. Two or three people getting into a carriage are obliged in a few minutes to admit fresh air by letting down a glass, or else the oppression becomes insupportable. In every place where there is no renewal of regular air the evil exists, and is only *greater* or *less* in proportion to the size of the room and the number of individuals who breathe in it. Air is, in fact, the first spring of life; aliment is but the second. We may live for many days without food; but shut out the access of air, that is, of oxygen to the lungs, and you instantly destroy life. On the purity of the air which we breathe, depends principally the health which we enjoy, our freedom from disease, and the length of our days. If a person is alone, he can only breathe the air he has before respired; but if others are in the same apartment, the breath of each person passes from *one* to *another*, and it is frequently in this way that diseases are communicated. I state an important fact, when I say, that in theatres and crowded assemblies of every kind; in close sitting and sleeping apartments, which are immediately offensive to a person entering from the open air; and in all situations where a man cannot have a gallon of pure air to breathe in every minute, (experience having taught us that that quantity is required) we are receiving and fostering in our system the germs of future disease, or we are calling into action principles of disease already existing, which might have for ever lain dormant; and thus by the operation of a slow and very insidious poison, we are still further shortening and embittering the short day of human existence. It is to men of science in general, and to those in parti-

cular who watch over our health, that it belongs to pronounce upon this important subject; I only take the liberty of presenting it for attentive consideration.

On conducting Air in Buildings by the Means of forced Ventilation, and regulating the Temperature therein.

From the same.

The general principle I have laid down as necessary to be observed for conducting the air, the only means of obtaining a proper regulation of the temperature in any building, are :—

First, By forcing upwards, either by a physical or mechanical power, a constant evaporation of all decomposed and impure air, and admitting below an equal renewal of fresh air, so as to promote a constant, although imperceptible circulation, and thereby render the atmosphere of every apartment, and every part of such building, *pure and healthy.*

Secondly.—By warming the fresh air admitted through a recipient for that purpose, to any degree according to the severity of the weather, or by admitting it in summer without the aid of artificial warmth, like the Zephyr breeze so refreshing in great heats, to spread throughout a temperature equally pleasant and agreeable, during every period of the year, thus neutralizing all dangerous draughts of air, and preventing the possibility of damp.

This is so simple that it will be said—who has not thought of it? Of what use is *forced ventilation?* Is it not known that lighter air must ascend, and that, consequently, wherever any opening is made above, all impure air will go out, and by a corresponding opening below fresh air must enter? Who does not appreciate the benefit of ventilation? How frequently has it not been

been spoken of? In what prison, hospital, theatre, or public building, is it not now adopted? Such are the natural reflections suggested by theory, and which might occur to every one—such were the first which presented themselves to my mind, and of which practice and experience alone have evinced the futility—the theory is doubtless infallible, as far as regards the calculation of weights, and would not in this case be liable to error, but that air, being elastic, is apt to be compressed, and that the least draught of a chimney, a door, or window, the direction of the wind, the density or rarefaction of the external or internal atmosphere, in short, a multiplicity of causes, change its direction.

I shall quote some examples in support of this assertion.

At the Bishop of Rochester's Palace, at Bromley in Kent, a calorifere stove was fixed, and external air admitted under the tubes which opened into the room, and when the fire was lighted, it sometimes happened that instead of warm air being introduced, the air of the apartment forced its way down the pipes and issued in a rarified state below, at the opening for the intended admission of external air.—In at least twenty other instances I have witnessed the same effect.

At J. Farrer's, Esq. in Lincoln's-Inn Fields a calorifere fumivore furnace was erected for warming two staircases. The warm air diffused itself into every part of the front staircase, and rendered the whole of that part of the house comfortably warm, but in the other (a high well-staircase entirely of stone) the air never rose above six feet higher than the place of its admission (about ten feet above the ground,) and the upper part of the staircase remained completely cold; the air even descended, and spread heat through the basement story; it even occasionally forced its way down the hot air-pipe, through the

the furnace, and issued at the lower opening where cold air should have entered.

At Sunbury Villa a furnace was erected to heat a pinery; at times the air passed through the furnace into the pinery, at others, it issued from thence through the furnace into the open air *.

At the manufactory, No. 121, Drury Lane, the staircase is warmed by a small furnace below. The first and second floors are uniformly at 60 degrees of heat, and the garret at discretion either warm or cold, and yet the staircase is entirely open.

At Covent-Garden Theatre.—Every precaution had been taken in building this theatre, to ventilate it in the most perfect manner, according to the principles of theory. In every part openings had been made in the ceilings, falsely called ventilators; from the boxes to the corridores; in every passage; and even in the galleries large openings communicated immediately with the carpenter's work-shop under the roof; yet the vitiated and stagnated air did not ascend; and the audience, after a certain time, continued breathing impure air, until oppressed with head-ache; and too often many left the theatre, having there laid the foundation of serious illness.

At Lloyd's Subscription-Rooms, as I am informed, the principles laid down by a celebrated learned man, who had been consulted relative to ventilating the House of Lords, had been adopted, and openings made in the ceilings of the different rooms, and in the floors, for the purpose of renewing the air.—Suffocating heat and op-

* It is perhaps needless to say, that by proper attention, and the precautions taken, the whole of the obstacles and inconveniencies here cited have been removed and remedied. They are given merely to shew the fallacy of maintaining, that rarefied air must in all cases ascend.

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pressiveness have nevertheless been complained of in Lloyd's Subscription Rooms, in which, as well as in the House of Lords, the benefit of ventilation has been but very imperfectly felt.

I could quote many similar facts, but I conceive those I have already brought forward will be sufficient to prove that no real ventilation had been established; that the appellation and the extreme want of it, only were known, and that the various causes which continually alter the course intended to be given to air, and render vague all the calculations of theory without practice, have never sufficiently occupied the attention of those, who, if they had reflected, must have foreseen at least much of what it has fallen to my lot to demonstrate.

If it is then allowed,—and I do not anticipate that any one will attempt to deny it—that, to procure ventilation constant in its effect, and not to be counteracted by such causes as those before cited, it is necessary to make use of a physical or mechanical power, the force of which must be calculated according to the obstacles it has to overcome,—it will be a never-failing source of satisfaction to me, to have been the first who has stated this fact in the form of regular principles; and I venture to hope, that forced ventilation will be generally acknowledged as an object of the highest importance to the health and prolongation of the life of man.

Having stated that to give any direction to air, at will, it is necessary to employ a physical or mechanical forcing power, I proceed to explain the nature of such power as I have hitherto made use of for the purpose.

The patent chimney-ventilator which from its construction forces a current of air upwards, whenever there

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is wind to act upon it, first occupied my attention.—Finding, however, that in calm weather its power ceases, and that air will even descend through the ventilator, if obeying a stronger impulse, I have, in order to render it effectual in all weathers, adapted to it a fire, or lamp, which producing a rarefaction of air, forces the current upwards at all times.

I have successfully employed a mechanical power, in various ways, but it being liable to be out of repair, I generally prefer the rarefaction caused by heat, which I have denominated "air-pump" in my specifications.

These different means I adopt according to the situation of the place, and the conveniencies to be found in it for ventilating, and it gives me much pleasure to say, that in every instance, the results I had anticipated have been completely verified.

By forcibly drawing up air, by these means, it becomes easy to give any direction to it in buildings; and having perfectly at command the admission of fresh air from the recipient below, the temperature throughout may be kept at any degree, however rigorous the season out of doors, while at the same time the atmosphere is never unpleasant nor unwholesome *.

* It is well known that in London air is loaded with a vast quantity of particles of smoke, or dust of coal, which make visible effects on our linen, furniture, &c.; but to witness the excessive quantity with which it is charged, it requires only to cause a current of air to strike against any body whatever, which in a short time becomes as black as if smoked. This circumstance caused me to invent a box, in which are introduced several sieves, each finer than the other, and having placed it at the place of admission of cold air into a furnace, I have been pleased to see that the air deposited the greater part of these particles, and consequently entered much purer, besides the advantage gained, in not having this dust falling on every surrounding object.

Application

Application of these Principles at No. 1, Russel Place; the late Metropolitan Bazaar; Covent-Garden Theatre; and Lloyd's Subscription Rooms.

At No. 1, Russel Place.

Three years ago, my late house in Russel Place, was exhibited to the public, and ever since it has been warmed and ventilated by the same furnace below, and has presented, during each winter, a perpetual spring temperature in every part, and this at little expense of fuel.

At the Metropolitan Bazaar.

The proprietor of the late Metropolitan Bazaar had two furnaces erected about eighteen months ago for the purpose of warming the whole of that large building; so effectually did these act, that the thermometer stood at nearly the same degree on every floor. To evince to the public its effect, I had ventilated the whole at my own expense, and all impure air was conducted by pipes from the upper part of each floor to the furnaces which acted as the forcing pump, and afterwards discharged into the different flues.

Nothing could be more demonstrative: but unfortunately that establishment was unable to support itself, and in the course of the summer fell a prey to fire, and I was deprived of the benefit I had hoped to derive from so publicly exhibiting the advantages of my method of warming and ventilating on a large scale.

At Covent Garden Theatre.

Having lost the opportunity of the Bazaar, and feeling more than ever the necessity of demonstrating in some public place the advantages of my plan, in order to call general attention to its utility, I requested a mutual friend

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to make a proposal to Mr. Harris, for warming and ventilating Covent-Garden Theatre, looking upon a large theatre as presenting an extreme case of the want of ventilation, and the utmost difficulty for procuring a regularity of the temperature, undertaking at the same time to withdraw whatever I might fix if it did not receive the sanction and approbation of the public.

It was certainly no small undertaking to devise the plan for drawing off continually the air breathed by two or three thousand persons; for suppressing all dangerous draughts or currents of air, (such as the immense column of cold air rushing into the interior on the rising of the curtain, and rendered still more pernicious by the degree of heat to which the numerous lights added to the breath of so many persons had previously raised the temperature of the theatre); for preventing similar draughts on the opening box doors; in fine, for spreading throughout a space so vast an equal, pleasant, and renewed temperature. Such were the difficulties to be vanquished, and as it may be interesting to scientific persons, and to the public at large, and satisfactory to the proprietors, I here give a detailed account of the means I have employed, and the different apparatus fixed for these purposes.

The first and most essential point being the complete ventilation of the theatre, I shall begin by describing the different means employed for that purpose.

A patent calorifere fumivore ventilating furnace is erected behind the lower gallery, which draws off the air from the back of the three first tiers of boxes.—The fire acts upon 12 pipes, of 7 inches diameter each, and 10 feet in length, which unite in a single pipe of 2 feet diameter.—A rarefaction is produced in these pipes, and the flame and smoke having passed them, are evaporated

porated by a large tube enveloping that in which the air from the boxes is carried off, and which not only continues but considerably augments the rarefaction, and quickens the current of air within.—These pipes unite at the top in a large cowl, which moves with the wind, and through which the air and smoke are discharged outside the buildiag.

TO BE CONTINUED IN OUR NEXT.

On the Laws relating to the Salt Duties.

From the REPORT of the SELECT COMMITTEE of the HOUSE of COMMONS.

THE Select Committee appointed to take into consideration the Laws relating to the Salt Duties, and the means of remedying the inconveniences arising therefrom, and to report thereon, with their observations and opinion, to the House, together with the Minutes of the Evidence taken before them;—Have proceeded to examine and consider the same, together with the Petitions, Reports, and other Papers, referred to them by the House.

YOUR Committee have, in the first instance, directed their attention to the Reports of the Committee appointed for the same purposes in 1801, as well as to that of the Committee appointed in the last Session to inquire into the use of rock salt in the fisheries, and to the evidence subjoined to their respective Reports; and finding that they have gone very fully into what relates to the manufacture of salt and the use of it in the fisheries, your Committee have thought it less material to call for much further information on those two subjects; and as the ob-

jections stated against the Salt Laws arise rather from the excessive amount of the Duties, and the severe penalties, forfeitures, and restrictions which have been deemed necessary to collect them, than from any misconduct in those appointed to carry them into execution; and as it appears, by the evidence of the Solicitor of the Excise, and by the account which he has delivered in to the Committee, that (except in cases of summary convictions) few informations for penalties in respect of salt have been prosecuted to judgment in the Exchequer, that many of them have been compromised after the suits were instituted, and the greatest part before any legal process had been commenced upon this subject; they have directed their attention to the means of removing general inconveniences by any practicable measures which may be found consistent with the secure collection of the public revenue.

The attention of the Committee of 1801 was directed to the entire repeal of the salt duties, by the substitution of a new tax adequate in produce to the salt duties, and less objectionable in its principle and operation; and they submitted to the judgment of the House their opinion, "that a commutation of the duties on salt would be productive of many great and important advantages to all descriptions of persons in this kingdom, and would be highly beneficial to its agriculture, fisheries, trade, and manufactures."

The late period of the Session at which that Committee had been appointed, made it necessary to postpone the consideration of the subject to the next session; when a very short peace, succeeded by a long and expensive war, operated to defer till the present time the consideration of this important subject.

Your Committee have, therefore, thought it their duty

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to endeavour to ascertain how far the inconveniences of the Salt Laws are capable of alleviation, and how far they have been alleviated by any measures adopted since the Report of June 1801, and the augmentation of the duties in 1805; and whether it may not be practicable, by such a reduction of the salt duties as would do away every impediment that now exists against the use of salt in agriculture, fisheries, and manufactures, to remove the present irresistible temptation to theft, smuggling, and fraudulent artifices.

To Great Britain, as a naval and commercial power, your Committee consider the home fisheries to be of the greatest importance, as (independently of the additional demand for labour and means of subsistence, and other advantages which they afford) supplying the best and most economical means of manning the British navy in time of war, and of giving occupation and subsistence to our disbanded sailors in time of peace. Your Committee do therefore regret to find, on reference to the statute books, that no material amelioration of the Salt Laws that relate to the fisheries has been obtained since the Report of 1801, while the duties have been raised from 20*l.* to 30*l.* a ton, with the exception of the permission to use rock salt, the full benefit of which cannot be yet ascertained; but, on the other hand, by a provision in the Act of last year, by which that permission was given, the peril of carrying salt coastwise was in some degree aggravated by making the master of the vessel liable to all deficiencies above one *per cent.* unless he can show the leak or leaks by which they have been occasioned to the satisfaction of the officer; this, which forms one of the most prominent subjects of complaint amongst those concerned in the fisheries, your Committee are of opinion, might admit of a degree of relaxation sufficient to afford

afford the means of giving relief in most cases where the deficiency had arisen from accident and unavoidable causes in the fair conveyance of the article from one port to another.

With respect to many other alleged grievances and inconveniences now subsisting, or which have subsisted since the year 1805 (in which period both the fisheries, and the number of those engaged in the trade of fish curing, have been considerably increased) your Committee have the satisfaction to believe, that in some instances they may be substantially removed, and in others in a great degree alleviated, without any material danger to the safety of the Revenue; and it appears to your Committee, that as far as this can be effected, it is desirable it should be done in the particulars of the amount of securities, the number of sureties, and the penalties to which they are subjected, the delivery of salt, the affording salt to the fisherman on the coast, the allowing an increased facility in the cancelling of bonds, and other minor points which might be enumerated.

Your Committee have examined the parties who appeared in support of several of the petitions in reference to these subjects, as well as others who were deemed by your Committee to be capable of giving valuable practical information; the evidence generally they beg to refer to the consideration of the House, and particularly that of Mr. Baine, Mr. Watson, Mr. Holmes, Mr. Bourne, Mr. Leigh, Mr. Twiss, and Mr. Marshall.

Before closing this head of observation, it should be remarked, that a difference in the mode of carrying the law into execution in England and in Scotland is alleged to exist, and that in the last-mentioned part of the kingdom particularly, the one *per cent.* allowed for waste in the carriage

carriage of salt, is habitually withheld, for which your Committee can see no reason.

The next object of your Committee's investigation, was the degree in which the manufacturers of the kingdom appear to be affected by the salt duties, and the laws enacted to enforce the collection of them. In the written evidence, which was last year laid before the Board of Trade, and which has been referred to your Committee, a variety of articles was enumerated, in the manufacturing of which salt is a necessary ingredient in different and generally in small quantities, and of which the duties on salt in a greater or less degree enhance the cost.

To some manufactures, in which it forms a more considerable ingredient, salt is, under the existing law, delivered duty free, as to those of glass and of oxymuriatic acid; in the latter article, the regulations under which it is allowed are a subject of complaint, from having a tendency to exclude the inferior manufacturer from the indulgence intended by the Legislature to be common to all. Your Committee's consideration of this point disposes them to believe the regulations complained of may safely admit of such an alteration as may extend the equal benefit of the indulgence to this description of manufacturers. In the present state of chemical science, and the rapid advances it appears to be making, your Committee are far from supposing that new and important applications of salt may not be discovered, highly beneficial to the interests of the kingdom; and whenever such applications shall be discovered, your Committee can have no doubt that Parliament will be disposed to extend to the manufactures dependent upon them, the same indulgence that is already extended to those above adverted to; one only has been stated to your Committee of this description, which is said to be obstructed by the existing duty

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on salt, that of mineral alkali, an object of great importance in the manufacture of soap, with which we are in a great proportion supplied from foreign countries. It has, however, been stated in evidence to your Committee, that the salts from which it could be made with equal facility as from muriate of soda (if it could be obtained by the decomposition of salt at all as an article of profitable manufacture) are to be at present had in sufficient abundance, at least for purposes of experiment, the use of which would be exempt from impost or restriction; and that, therefore, the impediment to the success of this manufacture cannot be justly imputed to the duty on salt. On this part of the subject, your Committee beg to refer to the evidence of Mr. Parkes, Mr. London, and Messrs. Hawes; but though no process has been specified to your Committee, by which alkali could be profitably produced by the decomposition of salt, yet as such a process may exist, or be hereafter discovered, they have thought it their duty to inquire how far in its consequences it might be one of public benefit, particularly as they had reason to believe considerable alarm to have been entertained in Scotland in reference to its eventual effects on the kelp trade: and it has been stated to your Committee, that if such a process should be discovered as would supersede the import of barilla, it might also, probably, supersede the use of kelp, and compel a large proportion of the population of the North-west coast of Scotland to the necessity of emigration: on this part of the inquiry your Committee beg to express no opinion, but refer to the evidence given by Mr. M'Donald, Mr. Stevenson, and Mr. Brown. The manufacture of sal ammoniac, an article of no great amount, formerly made in England, appears to have been in a great measure transferred to Scotland, on account of the advantages with which it is carried

carried on in that part of the kingdom; this has been attributed to the duty on salt, as also the transfer of a great proportion of the salt provision trade to Ireland, both in beef and pork; and it is particularly stated, that the distillers in London and its immediate vicinity, who had constantly fed as many as 30,000 hogs, did not now keep even one: and that of twelve wholesale starch makers who all kept hogs, there are only two who now keep any: whether the transfer of the trade to Ireland has been owing to the duty on salt, or to the difference in the prices at which beef and pork can be produced, the House will be able to judge on a reference to the accounts submitted to your Committee, and to the evidence of Mr. Adams and Mr. Cotterell.

Your Committee are strongly impressed with the great advantages that may be derived from the use of salt in feeding sheep and cattle, on the authority of Lord Somerville, (a letter from whom has been exhibited in a part of the evidence,) Mr. Curwen, Sir John Sinclair, Mr. Arthur Young, whose statements on this point they recommend to the particular attention of the House, as the ground on which they instructed their Chairman to propose a Bill, by which additional facilities might be afforded to the use of salt for this purpose, as well by a diminution of the duty, as relaxing the restriction under which it was granted by the Act of last year. In their expectations from salt, applied as a manure, they are much less sanguine; yet, believing it possible that in some cases, and under some circumstances, it may prove beneficial, and feeling the importance of affording every fair chance for satisfactory experiment, to ascertain its value in this respect, they have extended their recommendation to the allowing it on the same conditions for this and other agricultural purposes.

Your Committee are too much aware of the importance the House attaches to every thing which affects the condition of the poorer classes of the community, not to have made the effects of the salt duties on their morals and comforts a subject of their anxious inquiry.

In respect to the first, they have examined Sir John Stanley, Mr. Burton, Mr. Trafford, and the Reverend Mr. Broughton.

Mr. Burton, who for twenty-eight years was one of the Judges of the Chester Circuit, states to your Committee, that since the last augmentation of the duty in 1805, the temptation held out by it appeared to have been followed by a rapid increase in the crime of salt stealing; that several persons are united in stealing and carrying off salt, and he had no doubt that this has a tendency to multiply crimes of other kinds. In corroboration of this, Sir John Stanley, Chairman of the Summer and Autumn Quarter Sessions of the County of Chester, informed your Committee, that the effects of the salt duties on the morals of the people are so great, that they can scarcely be too strongly stated. On the other hand, a very different impression seems to be made on the mind of Mr. Trafford, a Magistrate of the county of Chester, who for many years acted in the neighbourhood of the saltworks; and of Mr. Broughton, who produced the calendars and sessions papers for the last seven years.

Of the frequency of another species of offence, fraud on the revenue, there can scarce exist a doubt, when it is considered that no article can hold out a greater temptation than salt to the commission of such offences, as well from the difficulty of detection as by the profit with which it is attended. With respect to the comforts of the poor, it has been stated, that the average consumption of a cottager's family, consisting of five, is about

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one bushel a year, which your Committee think rather a low estimate; and where there is the facility of keeping a pig or a cow, the consumption is naturally greater. It is true that, by law, the cottager on the coast may have his salt duty free, for curing fish; but he can only have it under a variety of restrictions, so inconvenient, as to render the provisions of the Legislature almost entirely abortive. The benefits and comforts which a repeal of the salt laws would confer on the poor in general, may be inferred from the power it would afford them to prepare their provisions at their own homes, at the season and in the manner best suited to their convenience and inclination, with an article which enters into almost every part of their subsistence.

Whatever opinions may exist as to the policy of totally repealing, or greatly alleviating the salt duties, it will be obvious, that in the present state of this country, financial objections to the measure will exist, until it can be ascertained that the public Revenue will not be materially affected by it, or a proper substitute can be found.

In the course of the evidence of Mr. Gilbert, a Member of the House, speaking of what must necessarily be a matter of conjecture, it is stated, that if the salt duties were so reduced as to do away the necessity of all restrictions, there can be no doubt of the use of salt being very greatly increased, and that such regulations and scales might then be devised, as would on the whole rather benefit than deteriorate the Revenue.

Your Committee have, therefore, inquired as to the scale and nature of reduction which might be adopted, so as to give the country the free use of salt at a reasonable price, and at the same time to supply the amount of the present revenue of the salt duties.

The principal increase of demand for salt which your

Committee can venture to look to in case of a considerable reduction of the duties, is in respect of sheep and cattle; the application of salt for this very beneficial purpose is general in many parts of the world, and the circumstance of its not being used in England, may principally be attributed to the excessive tax imposed on the article. The use of British salt in the Netherlands, and in the United Provinces, has been long known, and in Spain and Portugal also, its value is fully appreciated; it appears, therefore, not too much to presume, that what is frequently applied in other countries at considerable expense of carriage, might be soon brought into general use by the more enlightened farmers in the United Kingdom. Should this happen, and the application of salt to agricultural purposes become general in the United Kingdom, it might ultimately so extend the consumption of it, as to enable Parliament, without any sacrifice of Revenue, to make such a reduction in the duty as would destroy every temptation to fraud and evasion, remove every alleged grievance that is now ascribed to the salt laws, and furnish the means of realizing every advantage to the different classes of the community, and the great interests of the nation, which are dependent on the use of salt in the most unlimited extent.

Resolved, That it is the opinion of this Committee, that the repeal of the salt duties would be productive of the greatest and most important advantages to all descriptions of persons in this kingdom, and that the present state of the income and expenditure of the United Kingdom alone prevents your Committee from instructing their Chairman to move for leave to bring in a Bill for such total repeal.

Resolved, That in many points of grievance which have been brought under the consideration of the Committee,

mittee, a reasonable relief may be afforded without exposing the revenue to the danger of material loss.

Resolved, That as at the present period of the Session it is not practicable to pass a detailed law, in reference to the points alluded to in the last Resolution, your Committee have confined their instruction to their Chairman to the single point of furnishing salt to agriculture with additional facility, but it is desirable that a Bill should be brought forward in the ensuing Session; and that in the mean time any relief that can safely be given by official regulation should be afforded; and that means should be adopted to render the administration of the salt laws in Scotland in all respects similar to the administration of them in England.

Resolved, That it is the opinion of this Committee, that the consideration of this subject should be resumed early in the next Session of Parliament.

1 June 1818.

Instructions for the Management of Fruit Trees in the Nursery.

By JOSEPH HAYWARD, *Gent.*

With an Engraving.

From the SCIENCE OF HORTICULTURE, &c.

THE period of life allotted to us, compared to the growth of a tree, is short, and every person who plants fruit trees with a view to enjoy their produce, must consider the saving of a year, or the being enabled to enjoy the fruits of their labour and expense a year earlier, and consequently a year longer, (and this without lessening the future productive powers of a tree,) a most desirable object, and this may readily be attained.

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If plants are raised in such a manner that they may be removed with the whole of the roots entire, and without being curtailed or injured, the full benefit of a needful age, and progressive growth and extension of branches, may be transferred from the nursery ground to the garden or orchard, and no loss of time incurred; and this is easily effected when the soil is light, or it might be provided for either by having the beds or borders prepared with a stratum of light open earth, for the roots to run in, as hereafter described, or more perfectly by raising the plants in pots.

When the stocks or seedlings are planted with a view to transplantation, great care should be taken that the roots be drawn out even, and not crossed or bent; for if the roots are not first placed in a right posture, they seldom grow straight, or can be taken up perfect.

If apricots, peaches, plums, and all dwarf trees, are raised in pots of about fourteen inches diameter and depth, such trees may be trained two or three years to the full extent of their growth, and in proper shape, and be then transplanted, without receiving any check, or occasioning loss of time.

This process may be attended with a little more trouble and expense, but it would certainly give the nurserymen a better claim for double the sum than the price now charged for trees of more than one year old. And if those who are about planting consider their interest, they will rather pay twice the sum for trees raised in this manner, than what is now charged for those which are called trained trees, raised in the common way.

A peach or nectarine tree thus raised, and trained as hereinafter directed, may be removed the third autumn after budding, and the following summer produce several dozens of the finest fruit; the next year, (the fourth,) twice

twice the number; and the fifth year, upwards of forty dozen; and these are certainly advantages sufficiently great to counterbalance a trifling additional expense.

It will also answer as good a purpose to raise apple trees in the same manner; for when the roots of those trees are diminished or injured, they require a long time to recover the loss, indeed few more so, and after repeated transplantation, they seldom form handsome or healthy trees.

A standard tree of three or four years' growth from the graft near the ground, or one year, from a stem of due height, removed with its roots entire and uninjured, will make greater progress towards forming a handsome tree, produce more fruit, and in orchards get out of the reach of cattle, in less time than those raised and transplanted in the common way will do, of six or eight years old.

As to the mode and manner of performing the different operations of budding, or inoculating and engrafting, &c. I shall not attempt to suggest any improvement of the general practice; but it will of course be necessary, that the stock should be sufficiently recovered from its transplantation, and have taken good root, before it is operated upon.

All plants that are intended to be trained with two stems from the buds, such as peach trees, &c. should have two buds inserted opposite each other, and the stocks should be carefully looked over the spring next after budding; but if only one be inserted, or one only should grow, as soon as this begins to shoot, its top must be nipped off, to occasion it to throw out two branches of equal strength. As these grow, they must be carefully protected from being broken or injured; should one branch grow stronger than the other, the strongest must be fastened in a proportionally reclining position,

position, which will give the weakest a larger portion of sap, and forward its growth.

Should those branches during the first summer grow so fast or large as to endanger their breaking, when fastened down in the winter, which they sometimes will do, they may, during the summer or in the autumn, be fastened in a reclining position, proportioned to their size; but if not in this shape, and of a less height than four feet, they may remain until the next season.

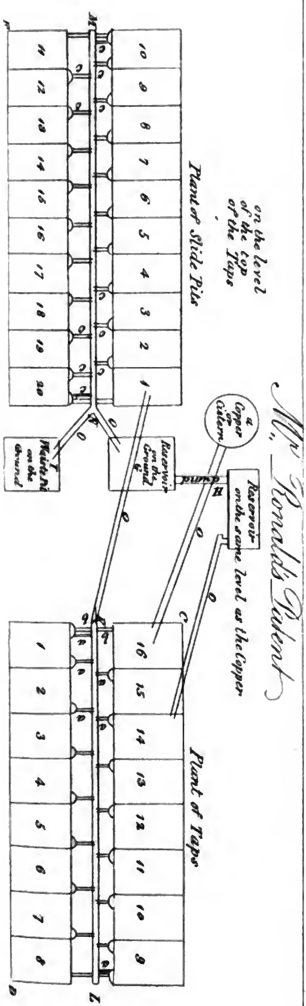
All collaterals or shoots springing from the sides of the stems, must be stopped immediately above the first bud, as they grow out, as this will incline them to grow more in height than in size, and render them more compliable.

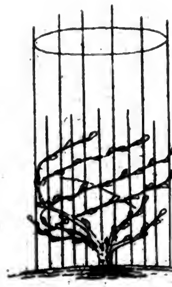
Those intended for the simple horizontal plan, as Fig. 2, (Plate VIII.) must be managed in the same manner, until the branches are six or eight feet long; and also such as are intended for one serpentined stem, until of a proper height.

Plants that are intended for spiral espaliers must be headed back, and managed so as to produce four or five branches of equal strength on a stock or stem of about six inches from the earth, and those permitted to grow erect, removing all collaterals, until they are from four to eight feet long, unless as before remarked, they grow so large and luxuriant as to endanger breaking, in which case they must be fastened in a reclining position, more or less, according to their strength, during the season of their growth.

Should the leading branches of any of those plants be by any casualty stopped, several buds will probably shoot; in this case, only one shoot must be permitted to grow, to continue it; all others must be removed as soon as perceived.

When budded trees are intended for standards, one shoot


Mr. Ronalds's Patent
Plant of Slide Pits
on the level of the top of the Taps
Plant of Taps
Reservoir on the same level as the Copper
a Copper or Cistern
Reservoir on the Ground
T Waste Pit on the Ground



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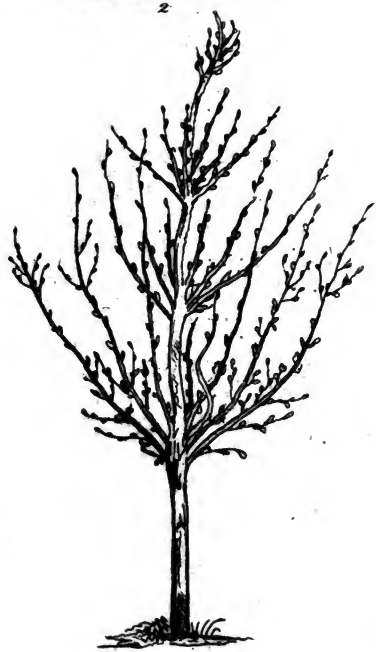


2

shoot only must be suffered to grow, and this carefully trained up, so as to continue rising from the point bud; and when stocks are grafted for standards, such grafts should be selected as have the point bud perfect, and the shoot produced by this should be carefully trained up and continued from the point bud.

When necessary to shorten the graft, previous to its insertion, it should be done from the lower or largest end; and if the grafts that are used have not the point bud, one shoot only should be suffered to grow, and this fixed as perpendicularly and straight as possible from the graft.

When grafts have taken to the stock, and have grown a few inches, they should be unbound and fastened, if necessary, to stakes, to prevent their being blown off, and all shoots except the leading one taken off.

If no accident occurs, these will require no other labour for two or three years; the point buds will naturally keep the lead, and in most kinds of trees form a straight and handsome stem.

Whilst the leading branch maintains the ascendancy, the side branches of the second year should remain on; they serve to strengthen and increase the size of the stem in a conical shape, until it has attained its utmost height, which should be about six feet, and this it will generally do the second or third year.

When a tree has attained its proper height, all the side branches below those intended to form the head, should be removed close to the stem; and when the stem is grown to its due height, which if left to Nature, will be determined according to the soil and situation in which it is placed, the buds that rise immediately about the point of the annual leading shoot, will generally form a circle of branches at the end of each year's growth; and those branches naturally arranged in regular tiers

and at proper distances, are best adapted for bearers of their different kinds of fruit.

Therefore with trees raised in this manner, (see Fig. 2, Plate VIII.) no branch will ever require to be shortened, the plant will progressively increase, and, as soon as it attains its proper extent of surface and age, will bear fruit, and which will generally take place much earlier than with trees that are headed back.

As the central or leading buds and branches are liable to be broken by accident, or destroyed by insects, it will be necessary to look over the grafts occasionally, and if two or more shoots are contending for the lead, all must be removed except the one that is best situated for continuing the stem; or if any of the leaders grow reclining, they must be fastened in a proper position to stakes.

Remarks on Dr. URE's "*Experiments to determine the Constitution of Liquid Nitric Acid,*"* *&c.*

By RICHARD PHILLIPS, *Esq. F. L. S. & M. Geol. Soc.*

From the JOURNAL of SCIENCE and the ARTS, Edited at the ROYAL INSTITUTION.

DR. URE has asserted, in his observations upon the composition of nitric acid, that "the exact proportion of its two constituents, azote and oxygen, is a problem which seems hitherto to have baffled the best directed efforts of modern science. M. Gay Lussac states, as its composition in 100 parts, 30.4 azote + 69.6 oxygen; and Mr. Dalton 26.7 azote + 73.3 oxygen. Thus discordant are the latest determinations." To which Dr. Ure adds, "I hope soon to be able to present to the public some

* Journal of Science and the Arts, vol. VI. p. 291.

researches,

researches, which may possibly tend to clear up this mystery."

I propose to examine the accuracy of Dr. Ure's opinion on this subject, by collecting and comparing the statements which have been recently made with respect to the acid in question, by philosophers of the highest reputation. The first to whom I shall refer, is Sir H. Davy, who observes in p. 265 of his Elements of Chemical Philosophy, " 101 will be the number for the acid contained in the pale acid, and in the salts called nitrates, and it will consist of one [proportion] of azote, and five [proportions] of oxygen." Now as Sir H. Davy represents a proportion of azote by 26, and one of oxygen by 15, nitric acid must be composed of

25.742	azote
74.258	oxygen
100.000	

The evidence which I shall next adduce as to the composition of nitric acid, is that stated by Dr. Wollaston, in his memoir on Chemical Equivalents. Alluding to some experiments which he had just described, Dr. Wollaston says, " I have no hesitation in preferring the estimate to be obtained from Richter's analysis of nitrate of potash, which gives 67.45, from which if we subtract one portion of azote 17.54, there remain 49.91; so nearly 5 portions of oxygen, that I consider the truth to be 17.54 [azote] + 50 [oxygen], or 67.54." If then 67.54 of nitric acid contain 17.54 of azote, 100 parts must consist of

25.97	azote
74.03	oxygen
100.00	

 To

To these determinations I shall add that of M. Gay Lussac, who is indeed quoted by Dr. Ure, to prove that discordance, rather than agreement, exists on this subject; if, however, Dr. Ure had extended his researches for evidence sufficiently, he would have seen that this profound chemist, with candour worthy of imitation, has acknowledged the inaccuracy of that analysis, which Dr. Ure erroneously supposes to be, and quotes as, the result of his latest experiments.

In the Annales de Chimie et de Physique, (tome i. p. 404.) M. Gay Lussac states nitric acid to be composed of 100 volumes of azote + 250 of oxygen; we have then merely to ascertain the comparative densities of these gases to determine their relative weights. According to Biot and Arago, equal volumes of azote and oxygen are to each other in weight as 0.96913 to 1.10359; therefore a compound of 100 volumes of azote and 250 of oxygen consists of

25.995	azote.
74.005	
100.000	

These numbers, it will be observed, are nearly identical with those which I have copied from Dr. Wollaston's memoir; they differ immaterially from those given by Sir H. Davy, and do not vary much from Mr. Dalton's analysis, as quoted by Dr. Ure.

Considering all who have preceded him in this inquiry, as having failed in the accomplishment of their intention, Dr. Ure appears to be very naturally anxious to supply the deficiency he has discovered. It would seem indeed, as if he had completed the investigation with no ordinary degree of celerity, considering the acknowledged difficulty of the subject; for when alluding in a subsequent

part

part of his paper, to the composition of liquid nitric acid, he says, " when we inquire more minutely into the peculiarity attending the above compound of greatest density, we shall find it to consist of 7 atoms of water = 79.24, united to 1 atom of dry acid = 67.5."

It is scarcely necessary to observe, that the number representing a compound body, cannot be ascertained without a previous knowledge of the proportions of its constituents; and it must be allowed, that Dr. Ure would not represent nitric acid by a number which he knew to be inaccurate; but having denied the correctness of every previous analysis, we are at liberty to conjecture that 67.5, as above quoted, result from the performance of those experiments, before the close of his paper, which he appears only to have contemplated at its commencement. But supposing this to be the case, it is very remarkable that Dr. Ure should not have allowed, that 67.5 is almost precisely the number by which nitric acid is represented on Dr. Wollaston's scale, for he is acquainted with this instrument, and even quotes it on another occasion to prove its inaccuracy: in the present instance, therefore, it would have been but candid to have excepted Dr. Wollaston from those whose efforts have been "baffled."

The principal intention of Dr. Ure in the paper now under consideration, is to determine the constitution of liquid nitric acid, a subject which he describes as " involved in perhaps still greater obscurity and contradiction," than that of the dry acid. To prove the justness of this observation, Dr. Ure quotes and compares the statements of Sir H. Davy, Kirwan, Dalton, and Dr. Wollaston, and he concludes them all to be erroneous.

According to Dr. Ure, 41.7 of carbonate of potash, consisting of 13.094 of carbonic acid + 28.606 potash, require

require 32.394 of dry nitric acid for their decomposition, and the nitrate of potash resulting weighs 61 grains: this determination agrees very nearly with Dr. Wollaston's scale, by which it appears that 41.7 of carbonate of potash, consisting of 13.26 carbonic acid + 28.44 potash are decomposed and converted into 60.94 nitrate of potash, by 03.5 of dry nitric acid; and as Dr. Ure considers that 32.394 of dry nitric acid are equivalent to 40.64 of liquid acid of sp. gr. 1.5, this acid must consist in 100 parts of

79.71	dry acid.
20.29	water.
100.000	

By Dr. Wollaston's scale, liquid nitric acid of sp. gr. 1.5 is constituted of 67.54 one atom of dry acid, + 22.64, or two atoms of water, 100 parts must therefore consist of

74.895	dry acid,
25.105	water.
100.000	

It appears then that whilst the composition of nitrate of potash is nearly similar according to these statements, in Dr. Wollaston's estimate the dry acid in liquid acid of sp. gr. 1.5 is to that of Dr. Ure, as 74.895 to 79.71.

Before I mention the experiments which I have made on this subject, I shall notice and compare Dr. Ure's statements with each other. I have already quoted a passage, in which he represents acid of a certain density, as consisting of 7 atoms, water 79.24 united to one atom of dry acid 67.5; these numbers appear to be from Dr. Wollaston's scale, and of course they are considered as correctly representing the quantity of water and acid in question. If, however, we compare these numbers with those

those which are to be derived from Dr. Ure's analysis of liquid nitric acid of 1.5, it will appear that this acid is composed of 67.5, one atom acid united to 16.79 water, and consequently of one atom acid, and one atom and $\frac{1597}{1137}$ of an atom of water,—a conclusion, of which it may be truly stated in the language of Dr. Ure, that it "exhibits internal proofs of inconsistency and error." To examine the subject experimentally as well as theoretically, I prepared some pure nitric acid, which had a sp. gr. of 1.496, so nearly 1.5, that they may be considered as identical in experiment. Of this acid, I saturated 150 grains with potash, and evaporated the solution of nitrate of potash to dryness; the salt obtained weighed 215 grs.; and according to Dr. Ure 61 of nitre contained 32.394 of dry acid, agreeing very nearly with 32.5, which is Dr. Wollaston's proportion. As then 61 give 32.5, 215 must contain 114.55 of dry acid derived from 150 of liquid. One hundred parts of the liquid acid appear to be composed of

76.367	acid.
23.633	water.
700.000	

The dry acid, it will be seen, exceeds Dr. Wollaston's estimate by 1.472, and is less than Dr. Ure's by 3.343.

It is easier, for obvious reasons, to obtain more accurate results with carbonate of lime than with carbonate of potash; I shall therefore now state the experiments which I have made with this substance. I ascertained some years since, that 476 grains of carbonate of lime require 681.75 of liquid nitric acid, sp. gr. 1.5, for their decomposition; and this determination has been noticed by Dr. Wollaston, as agreeing very closely with his views of the composition of liquid nitric acid. In order to try how

how much nitrate of lime would be obtained from the decomposition of a given weight of the carbonate, I put 150 grains of double refracting spar into a quantity of nitric acid, insufficient to decompose the whole of it; the platina crucible containing the solution of nitrate of lime, and the undecomposed carbonate, was heated till all the water was dissipated; on weighing, I obtained 243.2 grains. After dissolving the nitrate of lime in water, I found 3.4 of carbonate unacted upon; if then we subtract 3.4 from 150, the quantity of carbonate of lime originally used, and also from 243.2 the weight of the nitrate and carbonate of lime, it will appear that 146.6 of carbonate, were converted into 239.8 of nitrate of lime.

The experiments which I have now mentioned, show that 63 of carbonate of lime are decomposable by 90.23 of nitric acid 1.5, and that 103.05 of nitrate of lime result from their action; it will be seen by the scale, that 63 of carbonate of lime contain 35.46 of lime, which deducted from 103.05, the nitrate of lime, give 57.59, as the dry nitric acid contained in 90.23 of liquid acid of 1.5, or it consists of 74.91 acid + 25.09 water, a determination in which it will be seen, that the acid differs only about $\frac{1}{1000}$ part from the quantity stated by Dr. Wollaston.

With respect then to the composition of liquid, as well as of dry nitric acid, I conclude in direct opposition to Dr. Ure, that the subject is neither obscure nor mysterious; on the contrary, it appears to me, that the eminent philosophers, whose results he quotes to condemn, or whose conclusions he confirms or copies, have effected all the certainty which can be derived, from the "best directed efforts of modern science."

On

On the Cause of Blotches on the Shoots of the Peach Tree.

By Mr. JOHN KINMENT, *Gardener at Murie.*

From the TRANSACTIONS of the CALEDONIAN HORTICULTURAL SOCIETY.

I TAKE the liberty of sending to the Society a few hints respecting blotches on the shoots of peach trees, and on the proper soil for those trees.

There is, however, a malady to which these tender trees are very subject; concerning which, nothing within the reach of my information has been written: I mean certain black lifeless spots, which are very apt to appear on the young shoots during the summer months. I have often been sorry to see the shoots, not only of old trees, which we might suppose worn out, but also of young trees, whose shoots at first sight would be thought fair and luxuriant, with their young bark infected with that malady. It often gains ground, and proves fatal to the tree: at any rate it produces a very disagreeable appearance.

I have heard various reasons assigned as the cause of this disease, such as damp bottoms, and exhausted soils. If this malady only appeared on old trees, or on young trees planted on old borders, these conjectures might be adopted; but it is no uncommon thing to see these black spots appear on trees in new gardens, the first, second, or third year after planting. And from what I have experienced, in the course of the last two years, I think I may venture to suggest, that it proceeds chiefly from over dunging, or making the border too rich.

In support of this doctrine, I shall briefly state to you what I have experienced on this subject at Murie.

In the cold wet season of 1811, the peach trees, which had formerly looked well, and borne very profuse crops, gave evident signs of approaching decay; and I found it necessary, in the spring following, to supply their places with young trees. The border being very damp at bottom, I had it properly trenched and drained. I then dug pits for the young trees, about six feet diameter,—wheeled away all the old mould, and at the time of planting filled up the pits with new mould. It had occurred to me, that it might be the richness of the soil that produced the black spots.

Some time in the beginning of the winter, 1811, I collected together a rich compost heap (No. 1.), consisting of one-third light loam, one-sixth strong clay, one-twelfth lime, one-sixth hot-bed dung, one-sixth vegetable mould, and one-twelfth pigeon-dung. At the same time I collected another heap (No. 2.), much less rich, consisting of one-half light loam, one-fourth strong clay, one-eighth earth from scourings of ditches, one-sixteenth lime, and one-sixteenth hot-bed dung. These heaps I turned over occasionally, in order that they might be well meliorated by the frosts.

About the middle of March, 1812, I planted the trees, and applied to the roots of a few of them the rich compost of No. 1.; but the greatest number of them was planted with the compost No. 2. About the latter end of June I examined the young trees all over: the shoots they had made were nearly all of the same size; but I was no way disappointed, when I found those I had planted with the rich mould sadly infested with black spots; while those planted with No. 2 remained whole and sound. There being only the few which were planted with No. 1 infested with the black spots, with my knife I cut the blemishes entirely out; and about the latter end

end of September I found the wounds completely whole. Early in the spring, 1813, I cleared off the rich mould entirely from their roots, and supplied the vacancy with No. 2; and at the end of last season I had the happiness to see them succeed to the utmost of my wishes, free of black spots.

Murie, March 2, 1814.

On preventing the Mildew on Peach Trees.

By Mr. JAMES KIRK, *Gardener, Smeaton.*

From the TRANSACTIONS of the CALEDONIAN HORTICULTURAL SOCIETY.

I BEG leave to submit the following observations to the Horticultural Society, on the mildew upon peach-trees.

For more than nine years I have not had a mildewed leaf on any of the numerous peach-trees that are in the garden of the Honourable Mr. Baron Hepburn, at Smeaton, either in the hot-houses, or upon the open wall.

I ascribe this exemption from mildew, to my mode of management; which is this: in the months of January and February, if I see any of the trees in a stunted or sickly state, I take away all the old mould from the roots, as carefully as possible, and put in its place, fresh rotten turf from an old pasture, without any dung. This I have done in many instances; and all the times that I have practised it, the trees have never failed, not only completely to recover their health, but to produce a crop of fine swelled fruit.

Smeaton, Sept. 11, 1813.

On the Management of Sea-Cale.

By Mr. THOMAS BARTON, *Gardener, Bothwell Castle.*

From the TRANSACTIONS of the CALEDONIAN HORTICULTURAL SOCIETY.

THE *Crambe Maritima*, or Sea-Cale, appears now to be a vegetable in general cultivation, and brought to tolerable perfection on various soils, and by various modes of treatment; but in general it is found in the greatest perfection on a light sandy soil, of from eighteen to twenty inches in depth, being the nearest to that of which it is indigenous. Therefore, where such a soil is not to be met with, every means should be used to bring it as near to that quality as possible. In submitting a few practical remarks to the Caledonian Horticultural Society, respecting the cultivation and early production of this vegetable, I hope they will not altogether prove undeserving their attention, however short they may fall of indicating the most perfect mode of practice.

The soil in which I cultivate this vegetable is a pretty strong loam, on a loose till-bottom, which was previously prepared by trenching, from eighteen to twenty inches deep; at the same time mixing a good portion of vegetable mould, from decayed leaves, which had lain at least two years, to which I added a quantity of river sand. The ground is then laid out into beds, four feet wide, with two feet of an interspace, sowing two drills on each bed, about the latter end of March, or early in April; and with which may be sown any other light crop, leaving the interspaces for carrots, cauliflowers, or turnips; the ground being well prepared for such cropping, which does not in the least injure the young sea-cale plants, provided they are kept clear of weeds. In summer the plants should

should be thinned, leaving them from nine inches to a foot apart in the drills. In the autumn I cover the whole of the beds with leaves, as they are raked up from the pleasure grounds; covering each bed in thickness according to the strength and age of the roots, giving the greatest covering to the oldest, upon an average from five inches to a foot when first laid on: over this I place a slight covering of long dung, just sufficient to keep the leaves from being blown about. The covering is suffered to remain on the beds until the whole is cut for use the following spring; after which the dung and leaves may be removed, and the ground dug regularly over. By this treatment the heads will be found free and well blanched, and, from the sweetness of the leaves, free from any unpleasant flavour. As the heads become ready for use, they will raise the covering, by which means they will be easily perceived, without removing any more of the covering than the part where those heads are that are intended to be cut.

Those beds which I intend for early produce I do not cover in the autumn, as specified for the general stock; for a part will be lifted by that time, and the other before the approach of severe frost. I always leave the oldest roots for this purpose, (which are about five years standing,) keeping up a succession by sowing an equal quantity every spring. About the last week in October, or first in November, I commence taking up the roots for forcing, which is done in the following manner: open a trench at one end of the bed, and proceed in a regular manner, trenching the ground to the depth before specified (eighteen or twenty inches) in the operation of taking up the roots, which prepares it for another sowing. As the roots are lifted, I place them in a frame, previously prepared with a slight hot-bed for their reception, beginning

beginning at the back with the first row; putting some fine earth firmly about the roots, and so proceed until the frame is full, leaving the heads just above the surface; after which I put on the lights, and let it remain for a week or ten days, until all danger of over-heating is past. Then I take off the lights, and cover the surface of the bed with leaves, to the depth of four or five inches; adding more as I find the heat decrease, until the frame be nearly filled to the glass. If all has gone well, the sea-cale will be blanched and fit for use in three weeks, or a month at the farthest, from the time the roots are put into the frame. The retaining as much earth to the roots as possible at the time of lifting, I at first considered an object; but from experience I find it is of little consequence, provided the mould is made firm about the roots at the time they are placed in the frame.

The certainty of having this vegetable fit for use at any particular time it may be required, is an important object with many. Therefore, to such I would recommend this as a certain way of procuring it by any time that may be wished. The saving of *labour* and *dung* by this mode of treatment must appear obvious to every practical gardener, when he considers the difficulty attending the keeping up a proper and regular degree of heat, by covering with dung over pots, and other similar methods, (as generally practised,) at so inclement a season of the year; requiring three times the quantity of dung to produce an equal number of heads, to what will be necessary when the roots are placed in a frame; for a common melon frame will contain as many heads as are capable of being produced in two drills of twenty yards each, by covering with hot dung.

To keep up a regular succession, I find two frames, of three lights each, quite sufficient for a large family; the first

first prepared about the beginning of November, and the second about the last week in December; and by the time the second frame is exhausted, sea-cale will be ready for use in the open ground, where it had the thickest covering of leaves in autumn, and so on in rotation, as the beds have had less or more covering applied to them. The last cutting will be from what was sown the spring before.

Some may object to blanching the one year old plants; but I am induced to think they are not the least injured by it, for the slight covering that is given them, is only a requisite protection to them during the winter; and as they come in much later in spring than the old established roots, the season for this vegetable is prolonged a fortnight or more, and thus it is only making use of what it would otherwise be requisite to throw away; for if the young plants are suffered to remain with their flower-stems upon them, (which they seldom fail to produce,) it tends much to weaken, if not entirely destroy them. If, therefore, they are not blanched, they should be divested of the flower-stem, and this causes them to form a good stool for future produce.

Although the sea-cale is by no means a delicate plant, I find it is much benefited in the open ground by a slight protection during severe frosts, and particularly such as we have experienced the last winters (1813, 1814); during which, although uncommonly severe, I had not the least difficulty in affording a regular supply of this vegetable, by the method I have here endeavoured to describe.

Bothwell Castle, March 3, 1818.

List of Patents for Inventions, &c.

(Continued from Page 192.)

SAMUEL CLEGG, of Westminster, Engineer; for an improved gazometer, or gasholder. Dated July 24, 1818.

RICHARD BLAKEMORE, of Milingriffith-work, Glamorganshire, and JOHN JAMES, of Lower Redbrook, Gloucestershire, Iron-masters and Tin-plate manufacturers; for a new kind of plate, which they denominate *Armorphous Metal Plates*; and likewise a certain improved and more perfect method or methods of crystallising, or rendering crystallisable, the surface of tin plates, or iron or copper plates tinned, which they call *Armorphous Metal Plates*. Dated July 24, 1818.

JOSEPH MANTON, of Davies-street, Berkeley-square, Gun-maker; for certain primers for fire-arms; and also certain improvements in the construction of certain of the parts of fire-arms. Dated August 3, 1818.

JOHN MALAM, of Marsham-street, Westminster, Engineer; for certain improvements on steam-engines. Dated August 5, 1818.

JAMES HOLLINGRAKE, of Manchester, Lancashire, Mechanic; for a method of making or manufacturing copper or other metal rollers for calico-printing. Dated August 7, 1818.

⁂ *We are requested by Mr.* BATE, *of the Poultry, to state, that the History of the Kaleidoscope, which was inserted in our last Number, was sent to us by the desire of Dr.* BREWSTER, *whose name should have appeared as the author, in place of Mr.* BATE'S.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CXCVII. SECOND SERIES. Oct. 1818.

Specification of the Patent granted to Thomas Curson Hansard, *of Peterborough Court, Fleet Street, Printer; for certain Improvements on, and Additions to, Printing Presses, and also in the Process of Printing.*

Dated November 1, 1817.

With an Engraving.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Thomas Curson Hansard do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the following description thereof, and the drawings hereunto annexed; that is to say: My first improvement is the *Dividing Tympans,* which are capable of being added to any printing press, for the purpose of printing double sized sheets of paper, and then dividing or cutting such double size paper to the ordinary size of single sheets of paper: They are shewn in perspective at Figs. 1 and 2. Fig. 1, (Plate X.) representing the tympans turned down upon

the press, with the hindmost part of the inner tympan opened to shew the internal part. These tympans consist of, first, the outer tympan, Fig. 1, T T T T, of dimensions according to the size of the press or work required: the additions to which are, a plate of iron, steel, brass, or other sufficient substance, about seven-eighths of an inch in width, A A, Figs. 1 and 2; the back side, Fig. 1, of which is level, but the front side Fig. 2, is raised in the middle, the centre part being about one-fourth of an inch in thickness, and the two sides about one-eighth of an inch only, a part of the top or front of which is shewn in full size Fig. 3, and cross section of the same, Fig. 4; along the middle or thicker part are cuts or openings for the purpose of admitting the knife hereinafter described, leaving small parts of the plate uncut (as at *g g g*). On each side of the same, along the centre of the thinner part, is a row of small holes, at about half inch distances. This plate is fixed across the middle of the outer tympan, to each side, being countersunk into the same (*b b*, Figs. 1 and 2.) Secondly, the inner tympans are formed of two parts (Fig. 1, *c c c*, *c c c*,) having each part three sides, and moving on pivots at *dd*, attached to the outer tympan; these inner tympans, when shut down, are fastened in the common manner by hooks and eyes or buttons, each part when opened to adjust the blankets will incline back on the pivots *d d*. These tympans I cover with black linen of the most fine and even texture, rolled and hot calendered; taking a sufficient length in one piece to cover the one half of both tympans, then folding it in the middle, and laying such fold along the side rebate of the plate over the holes, I then firmly attach it thereto by strong sewing through the holes; I then turn one part of the fold of the linen over the outer, and the other part over the inner tympans, and sew or otherwise

otherwise fasten the same around the iron-work or sides and ends of the tympans in the closest and neatest manner, letting the hooks, eyes, or buttons, and pivots, through the linen, and keeping clear the openings for the point screws by carrying the linen on the inside, in the same manner as in putting on common parchment: the same operation then takes place for the other half of the tympans. I then take pieces of velvet, velveteen, or other uniform soft substance, which I attach, with the pile or softest side outwards, to the linen already described as being fastened to the tympans, by sewing or pasting it to the outside of the outer tympan, to receive the tympan-sheet, and by this means to give a beautiful and regular impression of the type: which mode of covering tympans I also apply to common presses.

The *Divider* or *Knife* is shewn, in front and back view, Figs. 5 and 6, and section of the same, Fig. 7, and is seen fixed on the frisket at *k*, Fig. 2; it is made of a plate of iron or steel, about three-fourths of an inch wide, turned down at a right angle on one side, about one-fourth of an inch in width, and in length sufficient for the width of the sheet of paper intended to be cut, and this must be fixed so as to be exactly corresponding to the openings in the plate A A before described; the part so turned down is cut into angular teeth, about a quarter of an inch from point to point, each tooth having two chisel-like edges, formed by being filed and dressed on the outside of the part so turned down; on the inside of the angle the teeth are to be finished all along fair and smooth; one or more of the teeth are then to be filed out at intervals corresponding with the parts of the plate left uncut (*g g g*). The pivots or joints of the tympans and frisket being accurately adjusted, the knife is then fixed to the frisket (at each end by screw or other connection), so that when

the frisket is turned down on the tympans, the knife shall freely enter the plate at the openings before described. The plate and knife now occupying the usual place of point screws and points, those necessary articles are removed to the centre of each half of the tympans above and below the plate, as *e e e e*, Figs. 1 and 2. If wished, the positions of the plate and knife may be reversed, by fixing the plate to the frisket and knife to the tympan, or a plate both on frisket and tympan, and knife to the form or table of the press, but not with equal certainty of operation. All these parts being properly adjusted, the mode of application is as follows: For making ready a form or sheet, the tympan sheet is drawn on the tympan, as in the ordinary mode, and the frisket pasted and cut out; but for working the first side of the paper the knife must be displaced (or, which is sometimes preferable, two friskets used, to be exchanged, one having the knife and one without): the whole of the paper being worked on one side without the knife; the knife is then replaced, or the friskets exchanged, and the reiteration proceeded with; the sheet will then be divided exactly along the centre, excepting at the parts where the portions of the plate have been left uncut, and the teeth filed out of the knife, as before described; which uncut parts answer the important purpose of keeping the double sheet adhering as one, for the pressman who may be pulling, to draw it off the tympans over to the bank, where it is finally parted by the other man who is beating while looking over his heap, when six or eight sheets are accumulated, by means of a gentle pressure with each hand at each end of the heap; the white paper or first side is worked with four points placed opposite to each other in the middle fold of each half of the double sheet as *e e e*, Fig. 2, but for the reiteration the two lower points

points are taken off, and the sheet kept in register by the two upper ones only. For cutting the sheet into more parts than two, I extend the same principle, by placing knives and plates in various positions, or at right angles with each other.

The *Demi*-(or half)-*chases* are made so as to contain the pages imposed within a less measure of square than usual; one side of the rim is made particularly strait, and rather less in breadth than the other three sides; this narrow side forms the part to lie in the middle of the table of the press; by turning a pair of chases so made on contrary faces, the two narrow sides will join and form as one chase; the pages are not in these chases, as in others for all sizes above folios locked up by having side-sticks and quoins on all four sides, but only on one side and at each end. The inner form being locked up on the right side only, and at each end, and the outer form on the left side only, and at each end; and the margin being made when the two demy chases are laid together on the imposing stone, as if the same were one large chase of double dimensions, the pages will require no more margin in the centre of the double sheet than a fair equal proportion for the division of margin. The chases must be made in proportion to the size of the work intended to be executed.

The Girths I form of lines made of any close-formed strong material or substance, but round or narrow, and I particularly prefer catgut of about one inch in circumference; such lines I arrange in pairs, one pair to run the table in, the other pair to run it out, applying them to the wheel after the manner of leather or web girths; except that such lines I place with a small degree of obliquity from either end of the table to the wheel, so that in winding round no one coil shall touch or interfere with the other, but take a spiral direction, one pair giving place by being wound

wound off the wheel as the table is run in or out, to the other pair, which by being then wound round the wheel causes the table to traverse in the given direction; by these means the rounce or handle will be, in every position or turn of the wheel, equally tight, and no friction or adhesion of the lines can ever take place.

Stereotype Plate risers, with Holdfasts or Claws.—The risers are made of type-metal, or any other metal or substance, cast in a type-founder's mould, having somewhat the form of what are called quotations. I take the usual standard for printers' admeasurement, and cast them quadrilateral to four pica m's; then longer ones as parallelograms, four by eight, four by twelve, and four by sixteen, and smaller ones four by two, four by one, four by a half; in height they are about three-fourths of an inch, or sufficient to raise the plate to the usual height, or somewhat higher, than common type; these being cast and dressed perfectly true in body and height, may be easily combined to form the size of any page necessary, with the certainty of having a uniform plain surface for all the plates however numerous; they are cast as hollow cubes, the larger combinations having divisions to give sufficient support to every square against any pressure which can be brought upon them.

The *Holdfasts* or *Claws* are formed of brass or other hard metal, accurately adjusted in thickness to a brevier, or any other body chosen, with a projecting bevil at the top; they may be of various lengths, as to 4, 8, 16, 24, or more or less, pica m's, the elongated parts of the larger ones being to the height of ordinary reglet, having the holdfast or claw in the centre or towards each end, as in Figs. 8, 9, 10, 11, 12, where they are shewn in full size; Fig. 8 being a side view of the bevil or claw, projecting one-eighth of an inch over the body, as seen in the figures following.

following. They may be opened, or pierced, as well to make them lighter, as to cause them, by pressing and indenting into the furniture of the form, to be less liable to be drawn out; the heighth of the claw is about seven-eighths of an inch, or sufficient for the projecting bevil of about one-eighth of an inch to lay upon the flanch of the plate when resting on the risers. To prepare plates for working, form with the risers the requisite number of pages for the form or sheet to the nearest size they may make by the various combinations, and add any difference wanting by reglet, leads, or scaleboard; then lay on the plates, and place at the head, foot, and sides of each plate as many holdfasts as may, from the size of the plate, be deemed sufficient for proper fastening; thus for small pages, as in octadecimos and duodecimos, one at each side and end will be sufficient; for larger pages, two or more may be thought necessary, making up the parts which they may be deficient of the length and breadth of the pages with quadrates or reglet of the same body; then proceed to make margin, or dress the forms, and lock up, in the usual mode. To change the plates; when worked, unlock the form, draw out the holdfast at the head or foot of the plate, slide off the done-with plate, replace by the new one, lock up again, and if the plates have been all cast true to one guage in thickness, width, and length, you will have throughout the whole work exact and uniform register and equal impression; when the work is completed, the same material of risers and holdfasts, by admitting every combination of size, will form into any other sized pages for any other sized plates. In witness whereof, &c.

Specification

Specification of the Patent granted to John Read, *of Tipton, in the County of Stafford, Gentleman; for a new System of working and getting the Main or Thick Mine of Coal.* Dated March 14, 1818.

With an Engraving.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said John Read do hereby declare that the nature of our said invention and the manner in which the same is to be performed, is described and ascertained by the following description and drawing; in which the dark or shaded part represents the portions of the mine of coal, which have been worked or are in the course of working, and the lines on the unshaded part describe the direction of setting out sections and ribs for working the coal remaining to be got.

This new system of working as particularly adapted to the main or principal bed of coal known to be in Staffordshire, Worcestershire, and part of Shropshire, commonly called the thick main or ten yard coal, and may be applicable to other thick veins, or mines, or coal in England and Wales, is intended to obtain a larger quantity of coal from such mines than has on the average been yet produced. Instead of working the coal by means of insulated or detached pillars, it consists in getting the coal in sections or divisions, from eight to twenty yards more or less in width, or as wide as the strength of the roof will admit one rib of coal from six to eight yards in width, or about one half of the width of the sections to be left between every two sections, and a great part of the coal in the ribs so left may be got afterwards. It is to be performed as follows: after driving out a gateway or road as in the old method, represented

represented by No. 2 on the plan, (Plate XI.) and taking the usual precaution to drive it to the deep part of the coal to be got; proceed to drive other gateways at right angles with the former, or as near to right angles as the nature, form, or position of the mine will admit, as shewn at No. 3, for the purpose of opening the work to get the coal; when arrived at the proper distance with these last roads, and which distance will vary according to the extent of the mine intended to be got, begin to open off or enlarge the gateway into as wide a section as the nature of the mine or the strength of the roof will admit, and which may be from eight to twenty yards more or less; then work such section back towards the main gateway, as at No. 4, being careful to leave a small rib or portion of coal from three to four yards broad against the main gateway, to support or protect it, as at No. 5; whilst this section is working back, drive other gate roads on a parallel line with the former, or as near to a parellel line as the nature, form, or position of the mine will admit, as at No. 6, to open other sections as the former become worked out, in doing which, you in each case cut off a rib, as at No. 7, the thickness or size of which ribs will as before depend on the strength of the mine and roof; they may be left from six to eight yards in width more or less, or about half the width of the sections. After the sections are all got, proceed to get the ribs, which being connected with the main gateway, a great part of the coal left in them may be recovered, by driving a gateway down them, as at No. 8, and working them back towards the main gateway; and the supports which form the main gateway itself are to be got out, and as you proceed with getting the ribs. It should be remarked, that it will be sometimes necessary to alter the direction of the main gateways, through the inter-

ventions of faults and deepings of the mine, which interruptions are well known to miners, and also from the form or position of the mine it may be necessary to alter the course of working, but not the system. This new system of working may be adopted, by getting the sections and abandoning the ribs, in which case the sections must be formed and worked as before; but the ribs may be left narrower. The new system may also be applied and worked upon by leaving the ribs broader. In this case the sections to be made of the same dimensions, and worked in the same manner as those already described, and broad ribs of about two-thirds of the width of the sections more or less, to be left between every two sections; and after the sections are all worked out, then proceed to work the broad ribs, which may be done in much the same manner as the ribs are already directed to be worked; but in getting such broad ribs, it may be necessary to leave some small portions of coal against the old works to support the workings. It should be remarked that levels to take off the water, and air heads to carry off the damp air, will be as much required in this system of working as in the old method.

In witness whereof, &c.

Reference to the Engraving.

1. Pitt shafts.
2. Main gateway.
3. Gateways.
4. Section working.
5. Coal left to support main gateway.
6. Gateway.
7. Ribs.
8. Gateway to get ribs.
9. Section worked and finished.

Specification

Specification of the Patent granted to JOHN PENWARNE, *Esquire, of Stafford-street, St. Mary-le-bone; for a certain Instrument, being an Improvement on the Cock, for drawing Beer, Cyder, and other Liquors from Casks and other Vessels, without the Intervention of a vent Plug or any opening whatever in the upper part of the Cask or Vessel, either for the Purpose of admitting Air or for affixing the said Instrument or Cock, or any Apparatus or Appendage belonging to the same.*

Dated January 31, 1818.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Penwarne do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, is described and ascertained in the following explanation thereof, and in the drawings contained in the margin hereof, and in the references to the same: The principles of my said invention or improvement are those of the syphon, or bear a very strong analogy thereto, acting by two several columns of different altitudes formed in the instrument itself, and by the liquor in the cask or vessel, that of the greater altitude by its preponderance overbalancing the other. For this purpose my invention contains two distinct cocks, though cast in one piece of metal, both of which have at all times an open communication as far as their respective plugs with the liquor in the cask or vessel. The larger cock through which the liquor is drawn contains the column of the greater altitude, which, on opening the cocks immediately acts, and by its preponderance withdraws the liquor from the smaller cock, and

the air is admitted; but at no time is there any immediate communication or open passage between the external air and the surface of the liquor to be drawn, but an intermediate one only through the liquor, the smaller cock delivering the air from its termination within the cask or vessel immediately into and in contact with the liquor at its own level, from whence it ascends to the surface by its levity, without any pipe or tube communicating with the surface of the liquor or with any space above it, nor requiring any opening whatever in the upper part of the cask or vessel, either for the purpose of admitting air, or for affixing the said instrument, it being fixed precisely in the same manner and with the same facility as the common cock. The principle of my said invention (as before stated) being that of two columns opposed to each other, that of the greater altitude ending in the lower cock, and that of the lesser altitude in the upper cock; I consider this as my peculiar invention in whatever way or form the columns may be constructed, this principle having never before to my knowledge been made use of, or practised in any instrument or cock for drawing liquor from a cask or vessel through the tap hole. And by way of distinguishing my said invention from all others, and as being expressive of its principle, I call it the *syphon cock.*

There being, as has been before observed, no immediate communication through these cocks, between the common atmosphere and the surface of the liquor or any space above, but only an intermediate one through the liquor, the air admitted ascending to the surface by its levity or inferior gravity to the liquor, it is obvious that the escape of the carbonic acid gas produced by fermented liquors, and supposed to tend greatly to their preservation, is rendered impossible (provided the cask or vessel

vessel be sound and tight), as the gas being of inferior gravity to the liquor, cannot descend through it, nor can any more air enter than is necessary to draw the liquor.

The above-stated principles may be carried into effect under various forms, but those which I consider as the most eligible are explained by the drawings in the margin, and by the following references to the same.

Fig. 1, (Plate XI.) represents the outward views of the instrument, shewing the connecting link which causes both plugs to turn at the same time; the handle or key for turning the same only partly appears in this drawing, being on the opposite side.

Fig. 2 represents the instrument in section, both the cocks being closed; A A marks the two extremities of the smaller cock; B B, those of the larger one through which the liquor is drawn. If the liquor in the cask should be in a state of fermentation, there would be a pressure on its surface from an accumulation of carbonic gas, and consequently a small quantity of liquor would for an instant issue through both passages; the outer extremity of the cock A A is therefore directed downward, that the liquor so issuing may fall without waste into the vessel held to receive it; the column formed by the cock B B is as superior to the one formed by the cock A A, as the distance between C and C. This column is formed partly behind or above the plug, and partly by the nose or spout of the cock; the part behind or above the plug being always full, is ready to act on opening the cock, and prevents any hesitation in its action which might otherwise occur, especially when the cask or vessel is quite full; when the instrument is not in action, the plugs of both cocks perform the office of common cocks by preventing the escape of the liquor, both being then full as far as shewn in the Plate; but when it is in action, the

pre-

preponderance of the column in the cock B B causes the liquor to retire from the cock A A, and the air is admitted.

Fig. 3 represents the exterior of another form, under which this invention may be carried into effect.

Fig. 4 represents the interior of Fig. 3. The cock is here shewn partly in section, the plugs being represented whole in order to explain the smaller one, where it being inadmissible for the passage to be made through it on account of the connecting bar which turns both plugs at the same time, it is effected by a deep groove passing somewhat more than half round the plug. The smaller end of the plugs are placed in opposition to each other, that by means of the square connecting bar which passes through the smaller plug, and the nut or screw at D, they may at any time be drawn towards each other, and tightened in their respective seats or sockets at pleasure. The letters A A, B B, and C C, refer in common to both the instruments above described.

Both cocks open or close with a quarter turn of the key, and are to be furnished with check pins as in other cocks. In witness whereof, &c.

Observations by the Patentee.

The numerous complaints of fermented liquours becoming vapid and sour, from servants neglecting to secure the vent plug, and the imperfection of vent plugs of all descriptions, have long since rendered a method of drawing liquor, without any opening whatever in the upper part of the vessel, a desideratum of the greatest importance; and which seems to be fully attained in the syphon cock, which will draw the liquor even if the vessel be hermetically sealed. The closeness of a bottle or a stone jug offering no impediment to its action, at the same time its application is as simple as that of the common

mon cock, and it is not more likely to be impaired by time or use.

The necessity of preventing the escape of the carbonic gas has been by few duly appreciated. It is that only which gives a grateful freshness to the liquor, and prevents its becoming sour, and which cannot be wholly preserved by any method requiring an occasional open communication of air to the upper part of the cask.

Figs. 3 and 4 are what any cock-maker most approves.

Specification of the Patent granted to DANIEL TOWERS SHEARS, *of Fleet Market, in the City of London, Copper-smith; for a Machine for the cooling of Liquids, and which may be applied to the Condensation of Vapour, and may be of great Utility in the condensing of Spirits in the Process of Distillation, and cooling Worts, Beer, and other Liquids.* Dated November 1, 1817.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Daniel Towers Shears, in compliance with the said proviso, do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be constructed, and to perform and operate, by the plans or drawings hereto annexed, and in the following description thereof; that is to say:

My invention consists of connecting and associating together a number of distinct or separate shallow or flat vessels or chambers, *vide* Fig. 5, Plate XII. (the size or form of the materials of which they are composed is not material, provided they are suited for, and capable of, holding

holding vapour or fluid,) each distinct or separate vessel or chamber having one or more in-let and out-let for the passage of such fluid or vapour as may be required to pass in or out of such vessel or chamber. In the construction of such vessels, and connecting and fixing them together, I employ any of the common well-known methods of uniting or connecting bodies together, by which vapours or fluids may be held or contained when any number of such vessels are connected and united together, (and I do not recommend less than six, nor more than forty vessels, although less or more may do,) they then assume the character of a machine for the purpose of cooling fluids or condensing vapours (*vide* the several drawings annexed). And although these vessels are thus associated, and although there are distinct in-lets and out-lets in each vessel, yet they are so placed that the out-let of one vessel becomes the means of feeding or supplying the in-let of the alternate or next vessel but one, into and through which the fluid or vapour is to pass. In a machine that is composed of six of these vessels, for the cooling of the fluid or for the condensing of a vapour, there will be three of the vessels to be occupied with cold water, and three to be occupied with vapour or wort, as may be required; and those six vessels will be placed in an alternate situation with each other, while the machine of forty vessels will have twenty for water and twenty for vapour or wort; that is to say, as in Fig. 1, will be seen a section of six vessels, and that the vessel A will contain cold water, while B will hold vapour or wort, C water, and D vapour or wort, E water, and F vapour or wort, and so on in alternate succession for any number of vessels that may be embodied, associated, or connected into the machine, or of which any machine for these purposes may be composed.

Fig.

Mr. Shears's Patent

Pl. XII. Vol. XXXIII. S.S.

Fig 1

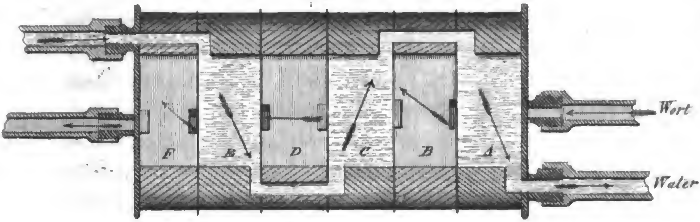


Fig. 2.

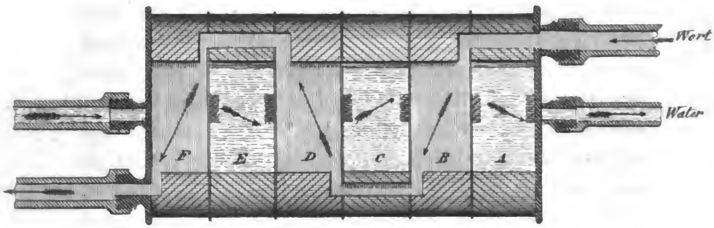


Fig. 3.

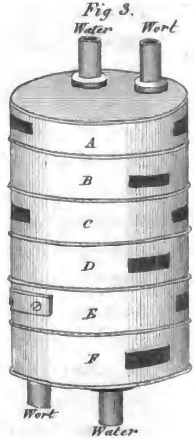
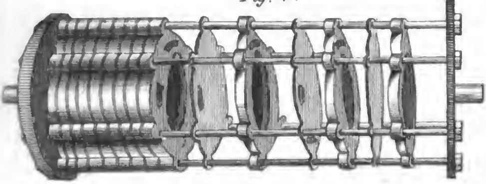


Fig. 4.



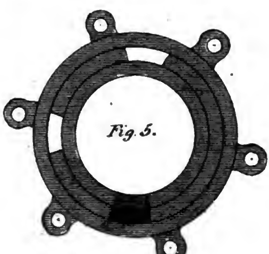


Fig. 5.

Fig. 1 (Plate XII.) shews the traverse of the vapour or wort marked out by the red colour, inclosed between sheets or columns of water, which are represented by the water colour.

Fig. 2 is a section of six vessels, shewing the traverse of the water through the machine in a meandering form, and travelling in an adverse direction to the vapour. The same colours in both figures are used to represent *water* and to represent *wort or vapour.* It is, as before stated, necessary that the vessels for holding cold water must have their inlet and outlet passages, by which a consistent current of water is kept up, and made to pass from water vessel to water vessel, compelling every particle of water in its journey through the machine to pass in and out of every water vessel, of which a machine is composed, until the water makes its ultimate and final escape from the machine; and the vessels that are to be occupied with vapour or wort must also have their in-let and out-let passages, and the fluids must be made to pass in the same manner, and in the same order, in and out of the vapour or wort vessels, as the water is made to pass in the vessels assigned for its journey, except that I would recommend that the water and the vapour, or wort, should be made to pass in opposite directions. A machine thus constituted, under a variety of modifications and proportions, (it being susceptible of a variety of modifications as to size, form, materials, and modes of uniting,) will furnish the means of cooling fluids, and of condensing vapours, with a facility and effect not hitherto accomplished by any of the implements in use for cooling fluids or condensing vapours.

It is obvious and clear, that this my invention of associating and connecting any number of shallow or flat vessels together, and filling one half in number of these

 vessels

vessels with cold water, and leaving the other half of the vessels to be occupied by wort or vapour; and by placing every vessel of wort or vapour between two vessels filled with cold water, (except the first and last, as the case may be,) and by forcing such wort or vapour through any convenient number of such vessels, the wort or vapour vessels always being inclosed between the cold water vessels, (except as before excepted), and thereby compelling the wort or vapour to travel in and out of the vapour or wort vessels, exposing the whole surface of the wort or vapour to equal surfaces of cold water; the operation of cooling liquids, and condensing vapour and spirits in the process of distillation, and cooling worts and other liquids in the process of brewing, must be materially facilitated and accelerated.

Fig. 3 represents a view of six vessels, connected together by bolts and nuts, shewing the inlet and out-let pipes both for the water and the wort or vapour, with two external openings to each vessel. These openings must, when the machine is at work, be closed so correctly as to render them air-tight; and any of the common well-known methods for rendering them so may be used. I have adopted a flat iron plate, with two strong screws, and a packing between the external part of each vessel and each plate. By these openings not only a convenient method of cleansing, but a ready and easy way of looking into each vessel is established as often as may be required.

Fig. 4 is a view of twelve vessels placed between two external plates or flanches of iron, with a suitable quantity of bolts or pillars and nuts to unite the whole firmly together, and which bolts or pillars are formed with a screw at each end, for at least four inches long, to fit their nuts, and by this length of screw at each end of such

such bolt or pillar, the nuts at such ends may be loosened, whereby each and every vessel may be separated from its adjoining vessel for the purpose of cleansing, repairing, or other alteration or amendment.

It follows of course that each vessel must have as many ears as there are bolts or pillars, and in each ear of each vessel there must be a hole to admit such bolts or pillars to pass through. I again also remark that each vessel must have a sufficient inlet and outlet passage. And that there must be a sufficient number of metallic plates and packings to render each of the twelve vessels distinct and separate vessels, as to their capability of holding either fluids or vapour, and have only the required and fit communications with each other, as shewn in Figs. 1 and 2. I have given the annexed drawings and their explanations merely to illustrate what I consider an easy and efficient mode of uniting any number of vessels, for the purposes before described, into the form and character of a machine; my invention is not for the means of uniting vessels together, but for the effect and advantage of such vessels when united, and by bringing distinct, shallow, or flat vessels or chambers together, and giving to them an alternate communication with each other, and for bringing the areas or surfaces of such vessels or chambers into contact with each other; whereby an extensive surface of any fluid or vapour may be brought through such vessels or chambers into near contact with equal surfaces of cold water, for the purposes of cooling and condensing fluids and vapour as before described. The means of feeding these vessels duly with cold water, and with wort or vapour, and of carrying off such water and wort or vapour from their respective vessels, or for permitting the atmospheric air to escape from the machine, by means of pipes, pumps, cocks, reser-

 voirs,

voirs, or any other well-known means of forcing and conveying air, fluids, and vapour, form no part of my invention; and I only employ those means when required for these several purposes, as auxiliary to my invention. In witness whereof, &c.

On Street Illumination.

By JOHN MILLINGTON, *Esq.*

Extracted from the JOURNAL of SCIENCE and the ARTS. Edited at the ROYAL INSTITUTION.

With an Engraving.

AT a time when the lighting up of our streets is so much improved by the almost general adoption of coal gas, any observations on this head may be deemed superfluous; but the possession of a good light, affords no reason for the waste of it, which constantly occurs from the dark colour, and light absorbing nature of the covers which are at present made use of for street lamps. It was not a little amusing, before the present general introduction of gas lights, to observe the various expedients which were resorted to in the streets of London, to augment the scanty pittance of light which was allowed to the inhabitants by the penurious contractors for the supply of oil; and the confines of each parish could be clearly ascertained by its bull's eye lenses, dazzling the eyes of the passenger at every thirty yards, and then leaving him in almost total darkness; or by the various contorted reflectors twisted into almost every shape which imagination could suggest, though in most cases without enough of optical knowledge to know what their effect would be until tried for a season, when they were most frequently laid by to give way to new forms equally inefficacious.

cacious. These were in a great measure rendered nugatory by the very excellent and ingenious lamp of Lord Cochrane, for which he obtained a patent, but which was afterwards set aside by the decision of a court of law. These lamps have been for some time used in the parish of St. Anne, Soho, and St. John the Baptist, Savoy Precinct, and are decidedly the best street lamps for oil which are at present in use. Their principle depends upon constantly admitting a current of atmospheric air to play upon a burner through a tube, instead of inclosing the flame in a glass vase, having but one common opening at the top for the passage of the smoke outwards, and the entry of that air which is necessary to support combustion; and by covering the whole opening of the glass vase with a concave reflector of planished tin placed above the flame, which reflects all that light downwards which in all other cases is lost. The flame of these lamps is made rather larger than usual, which of course implies a greater consumption of oil; but in this his Lordship was guided by true philosophical reasoning, since it was accurately ascertained by Count Rumford, that if burning 228 grains of oil in a given time produced 100 degrees of light, as measured by his photometer, that 441 grains consumed in the same time would yield 600 degrees of light; while 560 grains produced 900 degrees: and thus a six-fold light was produced by less than a double quantity of oil; and by the further addition of little more than half the first quantity, the original light was increased in the proportion of nine to one; which prodigious increase Count Rumford accounted for * on the present generally received doctrine of flame, viz. that as the particles of which flame is composed are so far

* See his Seventeenth Experimental Essay on Light.

cooled

cooled as to be no longer red hot, they cease to be luminous, and consequently to be visible; the object in all cases of illumination, is therefore to preserve the heat of flame as long as possible which will be accomplished by producing a larger fire from uniting the oil used in two lamps to be consumed in one wick in the same time, which by the foregoing experiments, owing to the increase of heat, will produce light in the proportion of 6 to 1. This circumstance was fully proved in St. John's parish before named, when although but half the usual number of lamps were used in the streets, at least three times as much beneficial light was produced, as by the old method.

Although the reflectors adopted by Lord Cochrane are the most efficient which I have seen for producing that equal distribution, instead of concentration, of light, which is so desirable in the streets of a town, yet they possess disadvantages which have not yet been overcome. They, in common with all the other reflectors I have seen, are made of planished or hammered tin, and so polished, that when new, they reflect a tolerably perfect image of the flame; but although tin, from its cheapness, is perhaps the best metal which can be used, still, notwithstanding they are better protected from smoke in Lord Cochrane's lamps than in many others, they are liable to oxydation or tarnish, by which they become inefficient; nor can they be expected to be kept in proper order by the parties to whose care they are entrusted, their numbers being great, and the time for attending to them very limited; besides which, tin, from being thin, is liable to bruises and loss of its proper figure, and as it consists merely of iron plates thinly coated with the soft metal tin, this soon wears away by cleaning, when all power of reflection is lost. Besides this, a perfect reflecting surface

face is not necessary, nor indeed so good, in a street lamp, as one which, from not absorbing the light, throws it downwards without producing a focus or concentration of light sufficient to dazzle the eyes of the passengers. My attention being drawn to this subject about ten years ago, I was induced to try a number of experiments upon the powers of different reflecting substances, and I found none of them so efficient for throwing down a plentiful and equally diffused light as the common glazed white earthen ware, of which dinner plates and dishes are usually made, and of which any one may convince themselves by simply holding a white plate in an inverted direction over a lighted lamp or candle. I proposed that flat circular plates or reflectors of this material should be made of a diameter equal to that of the opening of the glass vase containing the lamp, or the tin cover which is placed upon it, and that a hole of about two inches diameter should be left in the middle of the plate or reflector, or directly over the flame, wherever it might be, for the escape of the smoke, so that a plan of the reflector would appear like Fig. 1, (Plate X.) and a section through the middle of it like Fig. 2, which also shews the situation of the flame.

Upon mentioning this to some of the leading parties in a London parish, the only objections which were made were, the fragile nature of the material, and its liability to become smoked, and lose its reflecting power; and I was requested to make some trials on these points, which I have since done, though I have never till now thought of making them public. The result was, that if a lamp is properly trimmed and adjusted, (i. e. the wick not placed too high, which never is the case with the street lamps, which are contracted for), no detrimental quantity of smoke is deposited in two or three nights burning, and

and when it does accumulate, it is instantly removed by a bit of tow or rag, with much less trouble than is necessary to keep tin reflectors in order. These reflectors may be very conveniently fixed within the cover of the lamp so as to remove with it, by three or four bits of tin or wire soldered to it, and bent over the edge of the reflector, so that it has no chance of being broken except by a fall of the cover; and I find upon enquiry, that if such reflectors are obtained in a wholesale manner from the Staffordshire potteries, they can be furnished at from three halfpence to twopence each. The flat under surface of Fig. 2, will, I think, be the best for general use; but if a greater dispersion of light should be desirable, a reflector, of which Fig. 4 is a central section, may be adopted; and on the contrary, where a concentration of light is wanted, as over door-ways, the concave form of Fig. 3, the under surface of which is a portion of a hollow sphere, may be used.

Any of these reflectors, it will be seen, are applicable to Lord Cochrane's construction of an oil lamp; and since the general introduction of gas, which has in a great measure removed the objection of their becoming smoked, I think they will be found of utility to the public in all cases where light is to be cast downwards by reflection. Where the obstruction of an opake reflector would be detrimental, and it is desirable to diffuse light in all directions, and at the same time to concentrate it on one particular object, or in one line, the use of a hollow cone of polished metal or earthen ware, like a speaking trumpet, and having a similar opening at its apex, to the exterior of which the flame is to be applied, will be found very advantageous.

On

On the Powers employed for obtaining forced Ventilation; and of the Application of these Principles at Covent Garden Theatre and Lloyd's Subscription Rooms. By the Marquis de CHABANNES.

Extracted from his Pamphlet on that Subject.

With a Plate.

(Concluded from Page 227.)

FOUR openings have been made in the ceiling of each tier of boxes, which communicate separately with the pipes in the furnace before mentioned.—The evaporation of air through these openings becomes very powerful the moment the fire is lighted, as seen by the rapidity with which the wheels turned*. It is then evident that the breath of so many persons rising towards the ceiling by its lightness, unavoidably takes the direction of the current, and passes away, as a stream of water follows the fall which is given to it.

During the first months the ventilation in the centre was effected by steam; but Mr. Harris having since desired me to substitute the heat of the gas as a power, and to make all the necessary alterations, the chandelier has become a powerful agent of the ventilation. It should be observed, that the fly-wheels in the openings round the ceiling and in the boxes have merely been placed to satisfy the eye as to the vast evaporation of air. If any of them are observed to move more slowly, or to be entirely stopped, it is, that they have been thrown off their spindles, or damaged, by some mischievous persons, by sticks or otherwise, as has been the case several times,

*** These wheels have now been removed to prevent the noise occasioned by the extreme quickness of their motion.**

 but

but this does not in the least impede the current of air through them.

The third power is not yet established, but it is intended to be placed over the stage. Its object is to draw off the smell and heat of the stage-lamps as well as the burnt air they produce.

It is thus that all air which is in any way vitiated is constantly carried off during the performance. The constant evaporation of air from the theatre is visible to the eye, when, for the purposes of scenic representation, smoke is made upon the stage: it will be seen in a few minutes to have entirely disappeared by the various ventilators. It remains to explain how this air is replaced.

The pressure of the atmosphere acting with greater force upon the interior, in consequence of this constant evaporation of air, the audience would be exposed to the most dangerous currents on the opening of box doors, &c. if precaution had not been taken to regulate the temperature, in every part of the theatre, according to the degree of cold without. By examining the ground-plan of the theatre, (Plate XIII.) it will be perceived, that at every entrance or staircase communicating with the external air a Calorifere-Fumivore furnace has been placed. These are lighted as occasion requires, whenever the exterior temperature is below 50. Their power and effect may be immediately lessened or encreased by a damper in the smoke flue, and fire is discontinued whenever the thermometers in the theatre are from 55 to 60, according to the state of the weather. Three or four hours in the day are usually the time required to give a temperate warmth throughout, or to raise the temperature in any particular situation in which it may have been depressed; but however intense the cold without, by continuing the

fires

fires a few hours longer, the proper temperature may at all times be kept up in the interior. When the fire is out, warm air will continue to issue from the furnace till every particle of heat has been extracted from the pipes. If as soon as it is out the damper in the smoke-flue is shut, the heat may be retained a length of time, as there will then be only a draught through the warm air pipes, and not through the furnace itself, which, with the brick-work remaining warm, will continue to give heat to the air passing through the pipes as long as any remains in the bricks; and this renders these furnaces very economical. There are times, however, when it is not necessary to light the furnaces, and when an augmentation of heat in the corridores is still required; with this view it has been thought essential to place in the Shakspeare-room, saloons, and in the coridores, Calorifere stoves, which produce a quantity of warm air, and which on those days are sufficient to maintain the same temperature, and greatly assist, during the time of excessive cold, the effect of the furnaces.

The fresh air, which supplies the place of that evaporated, will therefore in cold weather be always at from 55 to 60, and will maintain a temperature proportioned to the heat in the interior of the boxes, so that it is impossible for any danger to arise from the opening of box doors, or any transition sufficiently great to be injuriously felt. But it was not sufficient thus to provide the means of maintaining the temperature of the corridores nearly at 60 degrees, it was necessary to regulate the admission of air into the boxes, to lessen the draught of air on opening the doors, and to supply constantly for respiration fresh air in lieu of that evaporated by the ventilation. This renewal of air is effected by numerous small openings which render the current insensible, and that air being

always at the degree before mentioned, produces a pleasing sensation, and is free from the danger and inconvenience which would be experienced from an admission of air at a colder temperature.

Such are the precautions which have been taken to insure a proper regulation of the temperature in the audience part of the theatre, but which would be counteracted in their effect if the stage had not also been maintained at a temperature nearly equal—for in that case, every time the curtain had been drawn up, the same unpleasant and dangerous sensations would have been felt which are complained of in other theatres, and which are the inevitable consequence of an inequality of the temperature of the stage, and of the audience part.

I have used steam to warm the stage, which had previously been tried without success, and by the means of forty-four patent cylinders, placed under the stage, (as seen in Plate XIII.) have been able to raise the temperature in every part, in the space of two hours, to 60 degrees, which effect is the more surprising, as every part below the roof is open, and contains more than two-fifths of this vast edifice.

A furnace, as powerful as that placed at the Bow-street entrance, might have answered the purpose, but there was no proper place, and steam having been before used, Mr. Harris offered me the use of his boiler, and of the conducting pipes already established *.

Also to prevent the effect of cold air, which would otherwise rush on to the stage by the doors at the back, which are constantly opening, and to prevent any disagreeable effect in the different passages to the dressing-

* A Patent Calorifere Fumivore boiler, which has procured a diminution of more than half in the consumption of fuel, has since been erected.

rooms,

rooms, &c. I have erected a patent Calorifere Fumivore furnace at both entrance stair-cases, (see Plate XIII.) so that during the whole winter the performers have been in an equal and pleasant temperature, from 55 to 60 degrees. I have also placed two patent Calorifere stoves in the Green-rooms, to aid the general effect, so that the passage from thence to the stage is always open, and no change of temperature felt.

I hope that this description will be satisfactory to those who would inform themselves on an object so interesting as the purification of the air, and regulation of the temperature, in all crowded assemblies; and without detracting from the great merits of the performers, which are certainly of the highest class, or the benefit of the alterations lately made, I also hope that some small share, in the decided preference which this theatre has enjoyed during the present season, may be attributed to the improvements which I have introduced, *at least* with regard to persons who dared not formerly visit any theatre through fear of head-ache, and who now resort freely to Covent-Garden; others, who give it preference in cold and damp weather from the certainty of finding it warm and comfortable, as well as to the crowds which nightly assemble in the different corridores which are always at a pleasant and agreeable temperature. During the course of the winter the thermometer has frequently stood, in the back of the boxes, as high as from sixty-five to seventy degrees, owing to the constant overflows at this theatre. This has rendered the benefit of the ventilation particularly sensible, from the air at that temperature remaining light and fit for respiration. Whereas, in theatres not ventilated and equally crowded, the heat would have been suffocating and intolerable.

At

At Lloyd's Subscription Rooms.

These rooms presented much difficulty for procuring a proper regulation of the temperature. They are spacious, and after ten o'clock in the morning persons assemble there on business. Till one o'clock, however, there is comparatively but a small assemblage; it is therefore in those first hours of the day that they require to be quickly and proportionably warmed to the temperature out of doors, while, from that time till after four o'clock, they are, on the contrary, so crowded that the heat is excessive, and there are few places in which one breathes so unwholesome an atmosphere, and where ventilation is more needed. This oppressive heat is not the effect of the fires, but is produced by the breath of so many individuals, and which not evaporating, causes in a short time the whole air of these rooms to become decomposed and impure.

At this time the doors of entrance, from the stair-case, are continually opening and shutting, and the most dangerous currents of air are forced into the room. The stair-cases being open to the external air *, these currents are particularly annoying to those persons seated near the doors. Theoretic expedients already had been employed for ventilating, and a multiplicity of apertures had been made in the floors and ceiling, but very little effect had been produced. Seven warm-air stoves, *the best then made in London,* had been fixed; but these were not sufficient to warm the rooms, and when the thermometer approached the freezing point, the Subscribers suffered as

* It is proposed to warm these stair-cases next Winter, so as to prevent this inconvenience to the subscribers.

much

much from cold in the morning as from heat in the afternoon.

To carry off all impure air, I have made use of the nine openings already made, having only substituted for the cowls which surmounted them, nine patent chimney ventilators, which, without assistance, draw up air whenever there is wind to act upon them, and I have added to each the power of a lamp, to be lighted in calm weather, or when quick and powerful ventilation is required from two till four o'clock.

I have also placed in each chimney, a patent ventilating box.

All vitiated air is thus drawn off continually, and there is not a person, though he may feel warm, but must perceive how much lighter the air is which he breathes than it was formerly, and consequently of how much benefit to him is the effect of the ventilation. I should have employed a simpler means of ventilating, could I have found a space to have erected a small furnace for the purpose, but that was not attainable. I have also fixed seven calorifere stoves, which, when in full force, will not burn half the fuel formerly used, but which produce at least three times as much heat as those they have replaced. The temperature of the rooms may, therefore, be elevated rapidly, and kept at an equal degree, whatever the cold without; it will depend on increasing and lessening the fires, and on the number; for it will be but seldom that the whole seven need be lighted, and the full power of warm air diffused into the rooms at the same time.

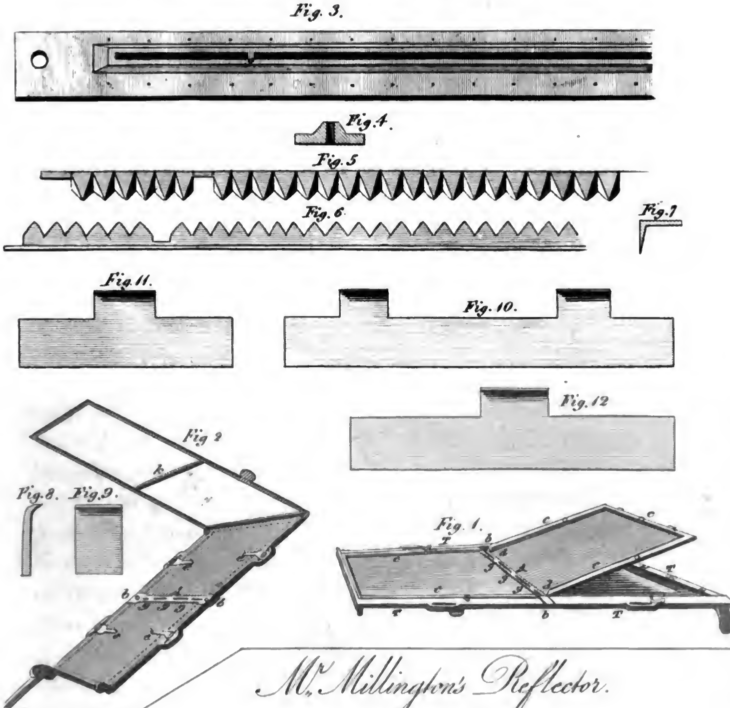
By these means I hope I have given the power of keeping the temperature of Lloyd's subscription rooms pleasant and comfortable, at every hour of the day and at every season of the year, and it will in future depend on

the

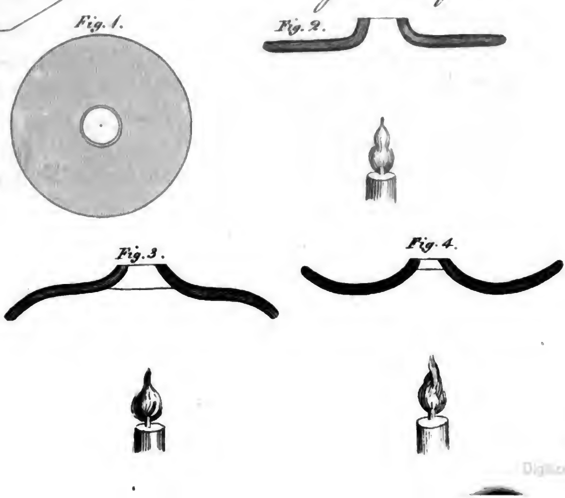
the attention of whoever is entrusted with the management. During the next summer and winter the subscribers will have the opportunity of witnessing its effects; but I am persuaded, that although some persons may occasionally be sensible of too great a degree of heat, and others of cold, there is no person of judgment and reflection but must feel the importance, and rejoice at being relieved from the necessity of breathing that air which has previously been inhaled by others. The difficulty of admitting a sufficient supply of fresh air through the floor, has left room for still further improvement. No more apertures could be made without proper application, but as soon as permission is obtained, the effect of the ventilation will be still more sensibly felt.

I have here cited these four examples for such persons as would satisfy themselves upon the merits of my plan, but at the same time I cannot refrain from observing how difficult it is, and how many sacrifices must be made to gain public suffrage, or favour, of the most useful inventions! There is certainly none more interesting to every individual than the purification of the air which he breathes, and the proper regulation of the temperature in which he dwells; there is not a physician, man of science, or any person able to judge for himself, who will deny this; but prejudice, custom, and habit, are so firmly rooted in man, that although easy to please, where his taste is flattered, there are objects of very great importance, yet to which it requires no small degree of perseverance to attract his attention, and which need only the trouble of enquiry and reflection to be highly valued.

Mr. Hansard's Patent.



Mr. Millington's Reflector.



Mr. Penwarne's Patent.

Fig. 1.

Fig. 2.

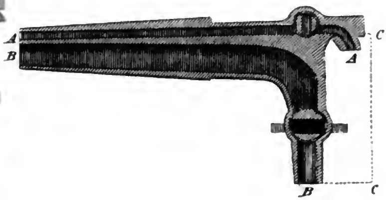


Fig. 3

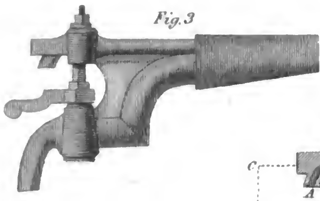
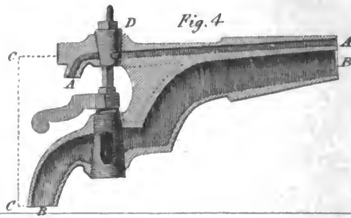
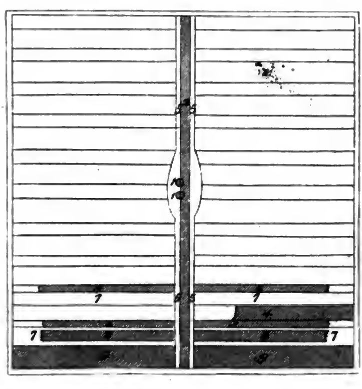


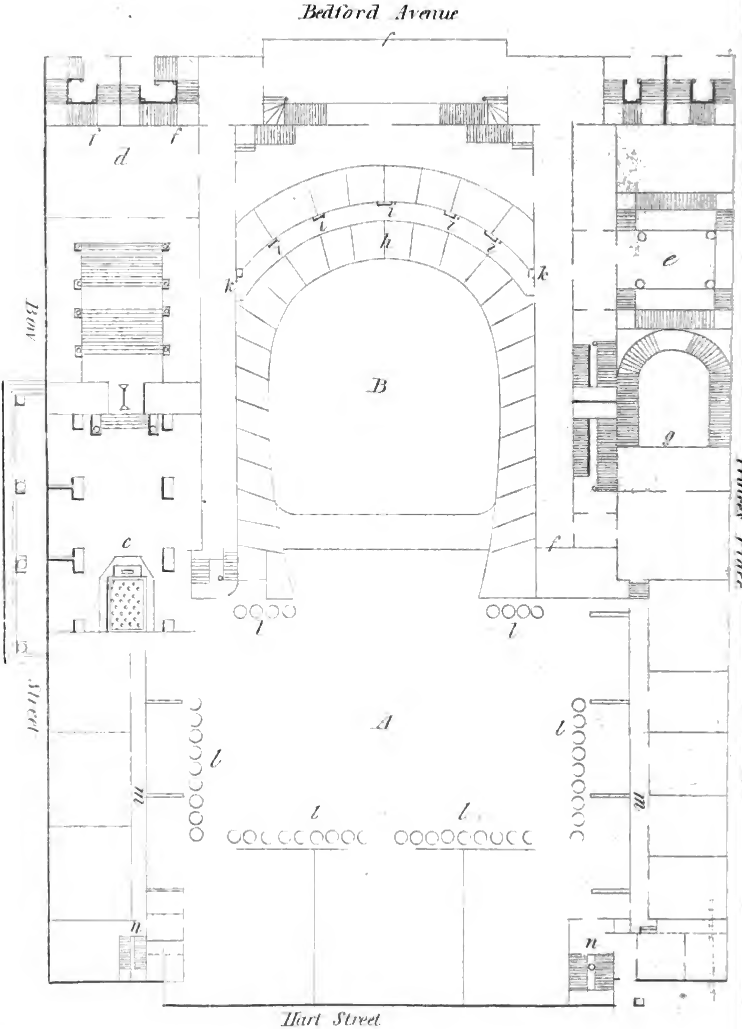
Fig. 4.



Mr. Read's Patent.



Pl. XIII. Vol. XXXIII. S.S.



Description of the Plate.

A. (Plate XIII.) The stage.

B. The audience.

c. Large patent calorifere fumivore furnace at the Bow-street entrance. It was necessary to give great power to this furnace, that from the warm air mixing with the external air admitted by the swing doors, the temperature of the grand staircase might be always maintained from 55 to 60 degrees, whatever might be the cold on the outside of the building. On the power of this furnace depends, in a great measure, the temperature of the corridores.

d. Shakspeare's room. This being a waiting room not only for the half-price visitors, but also for the public in going out while waiting for their carriages, it was essential to place two calorifere stoves, as at *f*, which producing three times more heat than a common stove, might maintain the corridores at 60, independent of the furnace, which must cease to be lighted when the thermometer is above 50 out of door.

e. Piazza entrance. A furnace is placed below this entrance, and the warm air is thrown out at each side of the flight of steps, by which means the air, which enters the body of the house through the doors above, is always at from 55 to 60 degrees.

f. Calorifere stoves in the lower saloon, and in the corridore of the dress circle on the King's side, as well as in the saloon, and corridores above, not seen in the plate, which diffusing a large quantity of warm air, are of great benefit in preventing any current of cold air between the boxes and corridores. They are more particularly required the days in which the furnace below is not lighted, in order to maintain a proper temperature in the corri-

 dores,

dores, by which, instead of feeling chilly in passing through them, one is, in every part, as comfortable as if in a moderate-sized apartment.

g. A furnace is placed underneath to warm this staircase, which leads to the private boxes on this side of the house, and one issue of hot air is also thrown into the private staircase leading to his Royal Highness the Prince Regent's box, in which a small patent calorifere stove has been placed, and which is ventilated by the same stove. The private box staircase on the other side being on a much smaller scale, a calorifere stove has merely been placed below to temper the air from the exterior.

h. A very powerful furnace is erected under the pit entrance, and the warm air is thrown up in three places, which are not marked in the plate, being under the boxes. The most powerful heat is in the centre of the corridore round the pit, and at this entrance outside the swing doors which are entirely open to the external air, but for the powerful heat issuing immediately between the first and second swing doors, the rush of air would be very dangerous. Thus the air, which is admitted into the pit and body of the house by the centre second swing door, is always at a temperate degree, and does away with the draught which formerly used to be complained of by persons in the front of the dress circle every time they were opened, and which would now be doubly injurious from the very powerful ventilation. The other heats are at the side doors into the pit, and have the same effect there, as well as preventing the cold from annoying persons seated in the front benches of the pit, by rushing to their legs and feet. It is further proper that the air in this corridore should be at 60 degrees, as it is from hence principally that air is supplied to the interior of the boxes

—blaze

—blaze openings communicate with the passage between the basket and dress circle immediately above, as at *i*, and would be dangerous and unpleasant if the temperature of the corridore, from whence it is taken, was not kept at an equal degree to those above.

i. Openings to admit fresh air in the corridore between the basket and dress-circle.

k. Two double wooden trunks, to supply fresh air to the first and second tier.

l. Forty-four patent steam cylinders placed round the mazarine floor underneath the stage, and supplied by a steam boiler.

m. Corridores running between the dressing rooms and stage, and warmed by the furnaces at each staircase entrance *n*.

n. Two staircases leading to the stage and all the upper dressing rooms. Two powerful furnaces are erected underneath, and the warm air discharged immediately in the centre of each, preventing any cold air rushing to the stage, and warming all the communications to it.

On the mechanical Structure of Iron developed by Solution, and on the Combinations of Silex in Cast Iron.

By J. F. Daniell, *Esq. F. R. S. and M. R. I.*

From the Journal of Science and the Arts, Edited at the Royal Institution.

In prosecuting my inquiries into the resistance which mechanical structure offers to chemical action, I have been led to bestow considerable attention upon the difference of the molecular arrangement of various kinds of iron. No subject stands more in need of illustration, nor is there any, perhaps, which is more likely to lead to useful

ful practical results, than one which concerns a substance of such primary importance to the arts.

I have failed to produce regular crystals in iron, by the means which I have successfully employed with the more brittle metals; but that, under certain circumstances, it does assume such forms, is fully demonstrated, by some observations of Dr. Wollaston, upon a mass of native iron, found in Brazil, and which have been published in the last volume of the Philosophical Trasactions (1816). From this Paper I shall make a short extract, for the double purpose of indicating the form of the crystals, and of confirming the general accuracy of my observations upon the resistance of crystalline arrangement to chemical action, by his authority. I am the more happy in being enabled to do this, as I have had but too much reason to suppose that my experiments had failed to produce conviction, where it was so much to be desired.

"The specimen of the iron with which Mr. Mornay very liberally supplied me for experiment, though it necessarily bears marks of the hammer by which it has been detached, presents also other surfaces, not only indicating that its texture is crystalline, but showing also the forms in which it is disposed to break, to be those of the regular octohedron and tetrahedron, or rhomboid, consisting of these forms combined. In my own specimen, *the chrystalline surfaces appear to have been the result of a process of oxydation, which has penetrated the mass to a considerable depth in the direction of its laminæ;* but in the specimen which is in the possession of the Geological Society, the brilliant surfaces that have been occasioned by forcible separation from the original mass, exhibit also the same configurations as are usual in the fracture of octohedral crystals, and are found in many simple native metals."

This

This spontaneous decomposition of the metal in the direction of its crystalline laminæ, is a new and valuable fact in the chain of evidence; and I have myself since observed an analogous instance of similar disintegration. In crossing the Alps, in the course of last summer, I remarked that the veins of carbonate of lime, which run in the mica slate, had their surfaces, which were exposed to the action of the atmosphere, *weathered* into distinct and well-defined rhomboids.

But to return to our subject. Although mathematical solids were not discovered by a solution of iron, yet a difference of structure was plainly discernible in the different varieties submitted to the experiment, which is well worthy of attention.

A cube of *gray cast iron*, of a granular fracture, was immersed in diluted muriatic acid. When the acid was saturated, it was taken out and examined. The size of the cube did not appear to be at all diminished, owing to a soft spungy substance, which had not been acted upon. This was easily cut off in large flakes, with a knife. Of this substance I shall have occasion to say more hereafter. The texture of the iron, of course, could not be learnt for this covering. But the metal having been submitted to repeated solution, the quantity of the residuary matter gradually decreased, and the surface being scrubbed with a brush, was found to be covered with small irregular ridges, which, when examined with a magnifier, presented the appearance of bundles of minute needles.

A mas of *bar iron*, which had undergone all the operations of *puddling* and *rolling*, was next submitted to the experiment. When the acid was saturated, it presented the appearance of a bundle of fasces, the fibres of which it was composed, running in a parallel and unbroken course

course throughout its length. At its two ends, the points were perfectly detached from one another, and the rods were altogether so distinct, as to appear to the eye to be but loosely compacted.

The next subject of examination was a specimen of *white cast iron*, of a radiated fracture. The first thing worthy of remark was, that it took just three times as long to saturate a given portion of acid as the two preceding specimens. Its texture, when examined, differed very much. It appeared to be composed of a congeries of plates, aggregated in various positions, sometimes producing stars upon the surface, from the intersection of their edges. It exhibited altogether a very crystalline appearance, but no regular facets were discoverable.

A small bar of *cold short iron* was next selected; it was exceeding brittle, and its fracture presented bright and polished surfaces much resembling antimony. Its texture, however, when subjected to solution, proved to be fibrous, but not so perfectly so as the first specimen of bar iron. The course of the fibres was very much broken, the acid having dissolved out small cavities which cut them short. It was a square bar, and the alternate sides were more acted upon than the others, so that the fibres would moreover appear to have been flattened.

A rod of *hot short iron* presented at the end of the operation, a closely compacted mass of very small fibres, perfectly continuous. The congeries was twisted, but the threads preserved their parallelism. A portion of a gun-barrel was submitted to the experiment. The metal was remarkably free from particles of an extraneous nature. The texture proved to be fibrous, but the threads were not regular or straight. They were generally disposed in waved lines, and the whole together was very compact.

A mass

A mass of steel just taken from the crucible in which it had been fused was subjected to the action of muriatic acid. It was of a radiated texture, the upper surface being marked with rays which proceeded from the centre to the circumference. It was readily acted upon by the solvent, and when withdrawn, presented a highly crystalline arrangement. It appeared to be entirely composed of very bright and minute plates which reflected the light in every direction. The laminæ were very thin, and there was no order discoverable in their mutual positions.

A specimen of cast steel, which had been subjected to the action of the tilting hammer, of a very fine white granular fracture, was next examined. It was not easily acted upon even by strong muriatic acid, and it required the addition of a small quantity of nitric acid to effect its decomposition. When the acid was saturated, the metal still presented a compact appearance; nothing of a fibrous structure was visible; but in one or two places where the acid had acted with most energy, it had detected the edges of laminæ, which appeared to form plates of the extent of the whole surface.

The blade of a razor composed of Wootz steel presented the same appearance, differing in nothing except three large notches in the back at right angles to the edge.

The blade of a razor of an inferior description presented a fibrous texture of waving lines. Deep notches in the back similarly placed were likewise visible in this. It was sufficiently evident, that the fibrous texture of this razor was owing to the admixture of iron and to the imperfection of the process for converting it into steel.

A bar of steel of an even granular fracture was broken into two. The two pieces were heated in a furnace to a cherry red. In this state one of them was plunged into cold water, and the other allowed very gradually to cool

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by the slow extinction of the fire. They were then both placed in muriatic acid, to which a few drops of nitric acid had been added. The last was readily attacked, but it required five fold as much time to effect the saturation of the acid of the first. When the solvents had ceased to act they were both examined. The tempered steel was exceedingly brittle, its surface was covered with small cavities like worm-eaten wood, but its texture was very compact and not at all striated. The untempered steel was easily bent, and not elastic, and it presented a fibrous and wavy texture.

I am inclined to hope that these observations may not be without interest, and that if properly followed up, they may lead to some useful practical results. We find that the excellence of iron for mechanical purposes depends upon its fibrous texture. The raw material, as we may term the crude cast iron, is better fitted for working in proportion as it approaches to this texture. We can trace a strong analogy between it and other fibrous substances. In flax, and hemp, the fibres are carefully separated from the other constituent parts of the vegetables by putrefaction and beating. In iron, the parts which are not fibrous are thrown off by a species of fermentation, called puddling and hammering. In the former, the fibres are interlaced with one another by tearing them into short pieces, and by a species of carding. In the latter, the same purpose is effected by cutting the bars into short pieces repeatedly, tying them in bundles, and again welding them together. The vegetable fibres are spun out into lengths, and are found to be tenacious and fitted for use. The fibres of the metal are likewise drawn out by rolling, and their acquired toughness adapts them to the purposes of the arts.

Might not the same twisting of the threads, which is found

found to give compactness and strength to hemp and flax, be employed with advantage to increase the tenacity of the particles of iron? Is there not something analogous to this in the waved structure of the gun barrel, which is known to be particularly tough? And may not the superior quality of the Damascus sword blades, which is still a problem to our manufacturers, be owing to some such management? Their structure would answer exactly to the idea of small rods of iron and steel welded and twisted together, and afterwards beat out. The experiment is worth the trial.

The good qualities of steel seem to depend for different purposes upon a varying mechanical arrangement of its particles. This difference of structure is conferred by certain regulations of temperature. We find that the same bar of metal suddenly cooled from a high temperature is possessed of a quite different texture, and different mechanical properties, from those which characterise it, when gradually lowered. May not the qualities of cast iron vary also with the rate of cooling? and might not a proper regulation of heat improve the fibrous texture, or even confer a certain degree of malleability?

I proceed now to a very different species of investigation, into which I was naturally led, while prosecuting the preceding experiments. I have mentioned above, that in dissolving the cube of gray cast iron, a porous, spungy substance was left untouched by the acid. This was easily cut off with a knife. It was of a dark gray colour, somewhat resembling plumbago. Some of it was put to dry on blotting paper, and in the course of a minute, spontaneously heated and smoked. In one instance, when a considerable quantity had been heaped together, it ignited, and scorched the paper. Its properties were not impaired by being left for days and weeks in the so-

lution of iron, or in water. I left some for three months covered with a solution of sulphate of iron, and exposed in an open dish to all the changes of the weather. At the expiration of that time, red oxyd of iron had been deposited from the sulphate, but the black matter when collected upon blotting paper, raised the thermometer twenty degrees. Muriatic and sulphuric acid both extracted the substance. When nitric acid was used, the plumbaginous matter was produced, but no longer heated in the air. I immediately commenced a series of experiments for the purpose of ascertaining the nature of a body which presented such a curious anomaly.

A portion of it just prepared was placed in a shallow dish upon the water trough, and a bell glass of common air inverted over it. The water gradually rose, and the residue of the air being examined at the end of twenty-four hours, it was found that the oxygen had been totally absorbed.

Another portion was put into a retort, to which a stop-cock had been adapted. The air was exhausted, and the moisture allowed to evaporate. Oxygen gas was then admitted. It became very hot, and the gas was absorbed. There was no change of appearance in either experiment. In chlorine it also became very hot, and a yellow liquid formed. This was washed out. A black powder was left of a high metallic lustre resembling plumbago. The solution was precipitated with ammonia, and afforded nothing but black oxyd of iron.

After the residue of the iron had absorbed its dose of oxygen, it was heated to redness, and digested in muriatic acid to take up all the oxyd of iron with which it was necessarily mixed. When well washed and dried, it exactly resembled that which had been prepared with chlorine; 320 grains afforded 95.6 of the metallic powder.

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The muriatic solution was precipitated by ammonia. The precipitate was boiled with a little nitric acid, and heated to redness. It weighed 166.8.

Muriate of barytes was poured into the solution of muriate of ammonia, from which the oxyd of iron had been collected, and a dense white precipitate of sulphate of barytes was formed, weighing, when washed and dried, 178.4.

From these preparatory experiments then, we learn, that the residue of the cast iron, after the action of sulphuric acid, heats, in consequence of its uniting with the oxygen of the air; and this residue, after it has so absorbed oxygen, is composed of

Oxyd of iron	166.8
Sulphuric acid	60.4
Gray substance, with metallic lustre,	95.6
	322.8

The increase of weight being probably owing to the higher oxygenation of some of the iron, by boiling in nitric acid.

The next object of inquiry, is the nature of the gray substance unacted upon by the acids.

Nitric acid, and nitro-muriatic acids, did not act upon it at a boiling heat.

When examined with a magnifier, it did not seem to be perfectly homogeneous in its composition, but presented the appearance of bright metallic particles, powdered and mixed with grayish white dust. It deflagrated with nitre and oxymuriate of potash at a very high heat.

Some of it was fused with pure soda in a silver crucible. When it entered into igneous fusion, a gas was given off, which burnt with flame, and slight explosion. When cold, it was of a greenish colour. It was dissolved

out with distilled water, and much of the powder was found to have been unacted upon. It was digested in muriatic acid, and had now assumed a brighter aspect, and was of a perfectly uniform texture, exactly resembling micaceous iron ore in small thin scales. The muriatic acid had taken up some oxyd of iron.

The sodaic solution was saturated with muriatic acid. It effervesced strongly. It was evaporated, and when reduced to about one half, it gelatinized. When perfectly dry, the muriate of soda was dissolved, and nothing but pure silex remained.

Guided by these hints, and by many other preparatory experiments, which it would be tedious to enumerate, I obtained the following more determinate results.

35 grs. of the gray powder, which had been thoroughly separated from all oxyd of iron, by digestion in muriatic acid, were exposed to a low red heat, in a silver crucible, with 200 grs. of pure soda. When a puff of gas took place, the crucible was instantly removed from the fire. The contents were dissolved out with distilled water. The solution was filtered, and the residue well washed and dried. It weighed 10.9 grs. It was digested in muriatic acid, again washed and dried. It then weighed 10.0. It now exactly resembled the micaceous iron.

The muriatic solution let fall a small quantity of red oxyd of iron upon the addition of ammonia.

The sodaic solution was saturated with muriatic acid. It barely effervesced. It was evaporated to dryness, and towards the end of the operation, it gelatinized. It was diligently stirred till dry. The muriate of soda was dissolved, and the remaining white insoluble substance heated to redness. It then weighed 23.8 grs. and possessed all the properties of silex.

Here then we arrive at another step of our inquiry; and

and we find that the 95.6 grs. of the gray substance, is composed of

65.0 silex,

30.6 metallic substance, like micaceous iron.

for 35.0 : 23.8 : : 95.6 : 65.

The small quantity of oxyd of iron obtained, and the slight effervescence of the soda, was owing, as we shall afterwards find, to the decomposition having been carried a little to far.

50 grs. of the micaceous substance, which had all been subjected to the action of red hot soda, were mixed with 500 grs. of pure soda, in a silver crucible. It was exposed for two hours to a heat just short of the melting of the silver. A large quantity of inflammable gas burned off. When this had ceased, the crucible was removed from the fire, and allowed to cool. It was digested in distilled water, and the solution passed through the filter. What remained was well washed and dried, and weighed 31.8.

This was digested in muriatic acid, and afterwards weighed 23.8.

The muriatic solution was precipitated with ammonia, and the red oxyd of iron weighed exactly 8.0 grs. corresponding to the deficiency of weight. The remainder was found to be the micaceous substance, totally unaltered in its characters.

The sodaic solution was neutralized with muriatic acid, and gave off carbonic acid in abundance.

It was then evaporated to dryness, and, during the process, it gelatinized. It was digested in distilled water, and the remainder, which was perfectly white, heated to redness. It weighed 5.8.

TO BE CONCLUDED IN OUR NEXT.

On

On the bad Effects of the incautious Use of Magnesia. By EVERARD BRANDE, *Esq.*

From the JOURNAL of SCIENCE and the ARTS, Edited at the ROYAL INSTITUTION.

AT a time when domestic empiricism is so prevalent as at present, it is important to point out the dangers which may arise from the uses, or rather the abuses of the most simple remedies.

Every medical practitioner must have repeatedly witnessed the serious, and sometimes the fatal consequences attendant upon the imprudent use of the stronger medicines, which are so extensively supplied for family consumption, particularly preparations of antimony, mercury, and opium, which, under a great variety of seducing forms and titles, are constantly employed; generally, however, they are, I believe, not sufficiently aware of the prejudicial effects of the too liberal use of magnesia; either those which may arise from its chemical action upon the urine, which are more immediately observable and common, or which may arise from its mechanical action, as an extraneous insoluble substance, and which are more remote, obscure, and rare.

I need not dilate upon the former, but may refer to my brother's observations upon that subject, published in the Philosophical Transactions for the year 1810, which, I regret, are too little attended to; and, with respect to the latter, shall confine myself to the recital of the following case.

A lady was recommended to take magnesia, in consequence of some very severe nephritic attacks, accompanied with the passage of gravel. She was desired to take a tea-spoonful every night; and Henry's calcined magnesia

magnesia was preferred, as that always operated upon the bowels and "carried itself off," which other magnesia did not, but, on the contrary, felt heavy and uneasy in the stomach. The dose was gradually encreased to two tea-spoonfuls, in order to produce effect upon the bowels, which this quantity never failed to do; the symptoms for which it was ordered were soon removed, but the plan was persevered in for two years and a half, with little intermission or irregularity; so that as the average weight of a tea-spoonful is at least forty grains, and the average dose was a tea-spoonful and a half, it may be presumed that she took during the above period between nine and ten pounds Troy.

In the course of the last autumn she suffered severely by a miscarriage, and shortly afterwards by an attack of biliary calculi; subsequent to which she became sensible of a tenderness in the left side just above the groin, connected with a deep seated tumour, obscurely to be felt upon pressure, and subject to attacks of constipation, with painful spasmodic action of the bowels, tenesmus, and a highly irritable state of stomach; these attacks recurred every two or three weeks, varying in violence, but requiring the use of active remedies; during one of them, about the middle of last March, a large quantity of sand was voided by the rectum, attended with a peculiar acute and distressing pain in the seat of the tumour above mentioned. This was lost. The following day, however, the same kind of evacuation happened again, and to the same extent, which being saved and measured, was found to amount to two pints. Another attack took place upon the 5th of April, when several irregular lumps of a soft light brown substance were voided, having the appearance of a large mass broken down, and when dry extremely friable: a part of each of these two last were subjected

subjected to a careful analysis, and found to consist entirely of sub-carbonate of magnesia concreted by the mucus of the bowels, in the proportion of about 40 per cent.

The use of magnesia was now given up, and that of an active purgative medicine enjoined, with some other necessary directions, and there is every appearance of returning health, although some slight attacks have recurred, and small portions of the same concretion still occasionally come away.

An instance, in many respects resembling this, has lately occurred in the practice of some gentlemen of eminence in this town, in which not only large quantities of a concretion of a similar description were voided; but upon examination after death, which took place perhaps six months after any magnesia had been taken, a collection, supposed to be from four to six pounds, was found embedded in the head of the colon, which was of course much distended. Some notes which were made of this case are, I fear, not to be found.

On the Food of Plants.

From the SCIENCE of HORTICULTURE, &c.

By JOSEPH HAYWARD, *Gent.*

THE food of plants has long been an object of anxious inquiry, and a great variety of conjectures have been formed as to what it consists of, or in what state it is taken up by the roots. It has been an object of research with men of the greatest talents and learning, and by them the powers of chemistry have been applied in a variety of ingenious experiments. The earth, as well as vegetables and animals, have been analysed and variously described, and accurate observations have been made and stated, but as yet none have been able to describe a theory

theory that has obtained general concurrence, or to establish a clear and practical rule of ascertaining the quantity and quality of the food of plants furnished by particular soils, nor the means of giving fertility or restoring it when exhausted by regulated proportions.

Although the earth appears capable of affording and sustaining a spontaneous produce in vegetables and fruit, her powers of production or principles of fertility are found to be limited, and possessed in different degrees by different portions; and it has been clearly proved that they are sooner or later exhausted by the growth of particular vegetables, according to the nature and situation of the soil; it therefore became an object essential to the Arts of Horticulture and Agriculture, to ascertain the nature of vegetables, and the composition of the soil most congenial to their different productions, in order to be enabled to remedy defects, remove opposing matter, and supply deficiencies, or, in other words, to sustain, increase or diminish the powers of production or principles of fertility.

Vegetables, like animals, vary in their nature and habits, and like them have their peculiar food, for although the food of plants may generally be composed of the same elements, it varies in the proportion of its composition, and thereby becomes adapted to different purposes; thus we find that a soil which will furnish only food enough to support one vegetable of a peculiar kind, will at the same time furnish sufficient to sustain many others of different species.

Bradley says, "Land animals may be likened in general to those plants which are called terrene, for that they live only upon the earth, such as oak, elm, beech, &c.; amphibious animals such as otters, beavers, tortoises, frogs, &c. which live as well on the land as in the waters, may be compared to the willows, alders, minths,

 &c.

&c. The fish kind, or aquatic race, whether of the rivers or the sea, are analogous to the water plants, such as water lilies, water plantains, &c. which live only in the fresh waters, or the fuci, &c. which are sea or salt water plants, and not any of these will live out of its proper element; from whence we may conclude how improper it would be to plant a water lily on a dry sandy desert, or an oak at the bottom of the sea, which would be just as reasonable as if we propose to feed a dog with hay, or a horse with fish; however, this rule of nature has been so little observed, even by some of our greatest planters, that we can hardly boast of good success in one out of five plantations that have been made."

He also says, "I shall beg leave to remark, that as the several land animals have their respective diets, so have the terrene plants their several soils from whence they derive their nourishment; as some animals feed on flesh, others on fish, &c. so do plants love, some clay, others loam, sand, or gravel; nor is this all we ought to observe, we must consider likewise how beneficial to every plant is a right exposure, whether in a vale, the sides or tops of hills, exposed to the south or north winds, whether inland or near the sea, for it is a proper exposure that keeps a plant in health."

Bradley, Hitt, and Miller consider the food of plants to be salts, which every species of earth, more or less, contains within itself; and that according to the proportion of salts contained in each kind of soil or manure will its prolificacy be.

That all soils and all vegetable and animal matter may be found to produce salts, under certain chemical processes, I have no doubt; but this does not prove it to be necessary that every substance, or any substance containing the basis or elements of salts, should undergo this process, and be formed into salts before it can be in a

state

state to constitute food fit for the reception and nourishment of plants.

Salts are various in their nature and general effects when placed in contact with other substances.

I have made many experiments with sea salt, nitre, soda, barilla, &c. &c. and feel myself justified in concluding, from the results, that salts are not in any degree an essential in the food of plants.

The opinions of Drs. Smith and Pearson on this subject, appear rational: they say, that salts, as they operate in promoting vegetation, are analogous to mustard, cinnamon, ginger, &c. which are not of themselves at all, or necessarily nutritious, but contribute to render other things nutritious by exciting the action of the stomach, and other organs of digestion and assimilation. Dr. Pearson also says, — "I have no doubt of the truth of the position, that no living thing, neither plant nor animal, can grow or live in a state of visible action, without supplies of matter that has been alive; in other words, living animals and vegetables can only live on dead animals and dead vegetables; no plant nor animal has ever been known by experience, nor in the nature of things does it seem reasonable, that they can be nourished by mere water and pure air, as some persons have asserted."

Mr. Kirwan, in an Essay on Manures and the Food of plants, as applicable to Agriculture, takes a very correct and comprehensive view of his subject.

Sir Humphrey Davy also has favoured the world with a very luminous work on agricultural chemistry.

Both those eminent chemists have minutely considered the nature of manures and the food of plants, and, no doubt, have explained their opinions and detailed their experiments with great clearness and perspicuity.

Were it not impossible for me, in a work like this, to

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convey an adequate idea of the information contained in either of those works, it would be imprudent and presumptuous to attempt it; but as I could not claim the merit of having done my best to elucidate my subject, without a reference to those splendid authorities, and finding it difficult to explain their arguments, experiments, and results, in any language equal to their own, I trust I shall be excused in making considerable literal extracts. Although in the general opinions and principles of those eminent chemists there appears to be a great coincidence, still I think it will be admitted that there is a sufficient difference to shew, that the subject cannot be considered as finally arranged or at rest, and that I may be justified in offering a few comments and ideas.

Mr. Kirwan observes, " The first essential requisite to a fertile soil is, that it contain sufficiency of the three or four simple earths, and of the soluble carbonaceous principle: the other requisites are, that the proportion of each and general texture of the soil be such as to admit and to retain as much water as is necessary to vegetation, and no more."

Sir Humphry Davy says, " The surface of the earth, the atmosphere, and the water deposited from it, must either together or separately afford all the principles concerned in vegetation; and it is only by examining the chemical nature of these principles that we are capable of discovering what is the food of plants, and the manner in which this food is supplied and prepared for their nourishment."

He also says, " By methods of analysis, dependent upon chemical and electrical instruments discovered in late times, it has been ascertained that all the varieties of material substances may be resolved into a comparatively small number of bodies, which, as they are not capable of being decompounded, are considered, in the present state

of

of chemical knowledge, as elements. The bodies incapable of decomposition, at present known, are forty-seven; of these, thirty-eight are metals, six are inflammable bodies, and three substances which unite with metals and inflammable bodies, and form with them acids, alkalies, earths, or other analogous compounds. The chemical composition of plants has, within the last ten years, been elucidated by the experiments of a number of chemical philosophers, both in this and other countries, and it forms a beautiful part of general chemistry; if the organs of plants be submitted to chemical analysis, it is found that their almost infinite diversity of form, depends upon different arrangements and combinations of a very few of the elements; seldom more than seven or eight belong to them, and three constitute the greatest part of their organized matter.

"All the varieties of substances found in plants are produced from the sap, and the sap of plants is derived from water or from the fluids in the soil, and it is altered by or combined with principles derived from the atmosphere.

"Soils in all cases consist of a mixture of differently divided earthy matter, and with animal or vegetable substances in a state of decomposition, and certain saline ingredients. The earthy matters are the true basis of the soil; the other parts, whether natural or artificially introduced, operate in the same manner."

Sir Humphry also says, "What may be our ultimate view of the laws of chemistry, or how far our ideas of elementary principles may be simplified, it is impossible to say—We can only reason from facts, we cannot imitate the powers of composition belonging to vegetable structures, but at least we can understand them, and as far as our researches have undergone, it appears that in vegetation, compound forms are uniformly produced from simpler

simpler ones; and the elements in the soil, the atmosphere, and the earth, absorbed and made parts of beautiful and diversified structures."

Kirwan states, "All plants, (except the sub-aqueous) grow in a mixed earth moistened with rain and dew, and exposed to the atmosphere; if this earth be chemically examined, it will be found to consist of siliceous, calcareous and argillaceous particles, often also of magnesia in various proportions, a very considerable quantity of water, and some fixed air. The most fertile also contain a small portion of oil, roots of decayed vegetables, a coaly substance arising from putrefaction, some traces of marine acid, and gypsum. On the other hand, if vegetables be analyzed, they will be found to contain a large portion of water and charcoal, also of fat and essential oils, resins, gums, and vegetable acids, all which are reducible to water, pure air, inflammable air, and charcoal; a small portion of fixed alkali is also found, some neutral salts, most commonly Epsom, tartar vitriolate, common salts, and salt of sylvius."

So far things are merely reduced to compounds, and the opinions of these great men accord; but Sir Humphry farther says, "If any fresh vegetable matter which contains sugar, mucilage, starch, or other of the vegetable compounds soluble in water, be moistened and exposed to air, at a temperature of from 50 to 80, oxygen will soon be absorbed and carbonic acid formed, heat will be produced, and elastic fluids, principally carbonic acid, gaseous oxyd of carbon, and hydro-carbonate will be evolved; a dark coloured liquid of a slight sour, or bitter taste, will likewise be formed; and if the process be suffered to continue for a time sufficiently long, nothing solid will remain except earthy and saline matter, coloured black by charcoal.

"Animal matters are in general more liable to decompose

pose than vegetable substances, oxygen is absorbed, and carbonic acid and ammonia formed. In the process of their putrefaction they produce compound elastic fluids, and likewise azote; they afford dark coloured acid and oily fluids, and leave a residuum of salts and earths mixed with a calcareous matter; the ammonia given off from animal compounds in putrefaction, may be conceived to be formed at the time of their decomposition, by the combination of hydrogen and azote; except this matter, the other products of putrefaction are analogous to those afforded by the fermentation of vegetable substances, and the soluble substances formed, abound in the elements which are the constituent parts of vegetables, in carbon, hydrogen, and oxygen."

Again, "The circumstances necessary for the putrefaction of animal substances, are similar to those required for the fermentation of vegetable substances, a temperature above the freezing point, the presence of water and the presence of oxygen, at least in the first stage of the process." He likewise says, "It is probable that as yet we are not acquainted with any of the true elements of matter."

It however appears that both animal and vegetable matters are reducible to the same principles, and so far simplified as to be clearly capable of the different combinations required to reproduce and sustain both animals and vegetables.

Kirwan observes, "Hence we see on the last analysis the only substances common to the growing vegetables, and the soils in which they grow, are water, coal, different earths and salts: these, therefore, are the true food of vegetables; to them we should also add, fixed air, though by reason of its decomposition it may not be distinctly found in them, or at least not distinguishable from that newly formed during their decomposition."

Sir

Sir Humphry adds, "Vegetable and animal substances deposited in the soil, as shewn by universal experience, are consumed during the process of vegetation, and they can only nourish the plant by affording solid matter capable of being dissolved *by the fluids in the leaves of vegetables;* but such parts of them as are rendered gaseous, and that pass into the atmosphere, must possess a comparative small effect, for gases soon become diffused through the mass of the surrounding air.

"The great object in the application of manures should be to make it afford as much soluble matter as possible to the roots of the plant, and that in a slow and gradual manner, so that it may be entirely consumed in forming its sap and organized parts."

So far the component parts of the food of plants seem to be generally understood and admitted; and on the medium of its application and consumption, Kirwan observes, "The agency of water in the process of vegetation, has not till of late been distinctly perceived: Dr. Hales has shewn, that in the summer months a sun-flower weighing three pounds averdupois, and regularly watered every day, passed through it or perspired 22 oz. each day, that is, half its weight. Dr. Woodward found that a sprig of common spearmint, a plant that thrives best in moist soils, weighing only 28,25 grs. passed through it 3004 grs. in 77 days, between July and October, that is somewhat more that its whole weight each day. He did more, for he found that in that space of time the plant increased 17 grs. in weight, and yet had no other food but pure rain water, but he also found that it increased more in weight when it lived on spring water, and still more when its food was Thames water. Secondly, that the water they thus pass, nourishes them merely as water, without taking any foreign substance into account, for 3.000 grs. of rain water, in Dr. Woodward's experiment, afforded

afforded an increase of 17 grs., whereas by Margraaf's experiments 5760 grs. of that water contain only ⅓d of a grain of earth: but, Thirdly, it also follows that water contributes still more to the nourishment of plants, besides the service it renders them in distributing the nutritive parts throughout the whole structure, forming itself a constituent part of all of them, may be understood from modern experiments. Dr. Ingenhouz and M. Senebier have shewn that the leaves of plants exposed to the sun produced pure air. Now water has of late been proved to contain about 87 per cent. of pure air, the remainder being inflammable air; *water is then decomposed by the assistance of light within the vegetable, its inflammable part is employed in the formation of oils, resins, gums, &c. its pure air is partly applied to the production of vegetable acids, and partly expelled as excrement.*"

This last theory will be found to harmonize with every practical observation, and must form the groundwork of every system of horticulture, arranged on demonstrative principles that can be expected to be supported with success.

Kirwan further states, "To Mr. Hazenfraz we owe the discovery, that coal is an essential ingredient in the food of all vegetables; though hitherto little attended to, it appears to be one of the primeval principles, as ancient as the present constitution of our globe, for it is found in fixed air, of which it constitutes above one-fourth part, and fixed air exists in lime stones and other substances which date from the first origin of things.

"Coal not only forms the residuum of all vegetable substances that have undergone a slow and smothered combustion, that is, to which the free access of air has been prevented, but also of all putrid vegetable and animal bodies; hence it is found in vegetable and animal

 manures

manures that have undergone putrefaction, and is the true basis of their ameliorating powers; if the water that passes through a putrefying dunghill be examined, it will be found of a brown colour; and if subjected to evaporation, the principal parts of the residuum will be found to consist of coal: all soils steeped in water communicate the same colour to it, in proportion to their fertility; and this water being evaporated, leaves also a coal, as Hazenfraz and Fourcroy attest."

Sir Humphry Davy says, "*No substance is more necessary to plants than carbonaceous matter,* and if this cannot be introduced into the organs of plants, except in a state of solution, there is every reason to suppose that other substances less essential will be in the same case. I found by some experiments made in 1804, that plants introduced into strong solutions of sugar, mucilage, tanning principle, jelly, and other substances, died; but that plants lived in the same solutions after they had fermented. *At that time I supposed that fermentation was necessary to prepare the food of plants, but I have since found that the deleterious effects of the recent vegetable solutions were owing to their being too concentrated, in consequence of which, the vegetable organs were wholly clogged with solid matter, and the transpiration of the leaves prevented;* the beginning of June in the next year, I used solutions of the same substances, but so much diluted that there was only about one two-hundredth part of solid vegetable matter in the solutions, plants of mint grew luxuriantly in all those solutions, but least so in that of astringent matter; I watered some spots of grass in a garden with the different solutions of jelly, sugar, and mucilage, which grew most vigorously, and that watered with the solution of tanning principle grew better than that watered with common water."

This

This experiment certainly shews the fertilizing powers of those vegetable substances, but as the decomposition of such substances, spontaneously takes place in so short a time, I think it most probable, that Sir Humphry's first idea was a correct one, and that they were reduced by fermentation to the common state of manures, before they became applicable, and that with the concentrated solutions, the accumulated gas resulting from the fermentation, destroyed the vegetables.

Kirwan remarks, "Vegetables not only require food, but that this food be duly administered to them, a surfeit being as fatal to them as absolute privation."

And further, "Hazenfraz and Fourcroy attest, that shavings of wood being left in a moist place for nine or ten months, began to receive the fermentative motion, and being then spread on land, putrefied after some time, and proved an excellent manure. *Coal, however, cannot produce its beneficial effects; but inasmuch as it is soluble in water,* the means of rendering it soluble are not as yet well ascertained, nevertheless it is even now used as a manure and with good effect.

In truth, the fertilizing power of putrid animal and vegetable substances were pretty fully known even in the remotest ages, but most *Speculatists* have hitherto attributed them to the oleaginous, mucilaginous, or saline particles then developed, forgetting that land is fertilized by paring and burning, *though the oleaginous and mucilaginous particles are thereby consumed or reduced to a coal,* and the quantity of mucilage, oil, or salt in fertile land is so small, that it could not contribute the 1000th part of the weight of any vegetable, whereas coal is not only supplied by the land, but also by fixed air combined with the earth, *and also by that which is constantly let loose by various processes, and soon precipitates by superiority of its*

 specific

specific gravity, and is then condensed in, or mechanically absorbed by soils, or contained in dew."

This corroborates my preceding observations, and exhibits a difference in the opinions of those authors; but it is of no great importance, as Sir Humphry Davy also says, "mucilaginous, gelatinous, saccharine, oily, and extractive fluids, and solution of carbonic acic in water, are substances that in their unchanged states contain almost all the principles necessary for the life of plants; but there are few cases in which they can be applied as manures in their pure forms, and vegetable manures in general contain a great excess of fibrous and insoluble matter, which must undergo chemical changes before they become the food of plants."

On earths Kirwan says, "The next most important ingredient to the nourishment of plants is earth, and of the different earths the calcareous seems the most necessary, as it is contained in rain water, and absolutely speaking many plants may grow without imbibing any other. *M. Ruckert is persuaded that earth and water, in proper proportions, form the sole nutriment of plants.* But M. Giobert has clearly shewn the contrary; for having mixed pure earth of alum, silex, calcareous earth, and magnesia in various proportions, and moistened them with water, he found that no grain would grow in them, but when they were moistened with water from a dunghill, corn grew in them prosperously—hence the necessity of the carbonaceous principle is apparent."

He also says, "Earths cannot enter into plants but in a state of solution, or at least only when suspended in water in a state of division as minute as if they really had been dissolved; that siliceous earths may be suspended in such a state of division appears from various experiments, particularly those of Bergman, who found it thus diffused in the purest waters of Upsal; and it is equally certain

certain that it enters copiously into vegetables. Both his experiments, as especially those of Macie, establish this point beyond contradiction. Argillaceous earth may also be so finely diffused as to pass through the best of filtres; so also may calx, as appears from the quantity Margraaf found in the purest rain water."

On this part of the subject, after reciting a number of experiments, Sir Humphry Davy observes, "The general results of this experiment are very much opposed to the idea of the composition of the earths by plants, from any of the elements found in the atmosphere or in water."

He also says, "As the evidence on the subject now stands, it seems fair to conclude *that the different earths* and saline substances found in the organs of plants, *are supplied by the soils* in which they grow, and in no cases composed by new arrangements of the elements in air or water."

Here again is a difference in the opinion of those great chemists, but as it may be considered as theoretical, it is of little importance; the grand principle seems admitted to be demonstrated, *viz.* that earths are a necessary ingredient in the composition of plants, that no substance can be taken into the system but in a state of solution, and that all the earths, siliceous, calcareous, and argillaceous, are not only capable of solution, but are contained in all waters in the common state.

Carbonic acid seems also to be considered as an essential article of food; and Kirwan further remarks on this subject—

"*That plants do not thrive, but most frequently perish, when surrounded by an atmosphere of fixed air,* has long been observed by that great explorer of the most hidden processes of nature, Dr. Priestley; *but that fixed air, imbibed by the roots, is favourable to their growth,* seems well established by the experiments of Dr. Perceval of Manchester,

chester, and fully confirmed by those of M. Ruckert. This last mentioned philosopher planted two beans in pots of equal dimensions, filled with garden mould; the one was watered almost daily with distilled water, the other with water impregnated with fixed air, in the proportion of half a cubic inch to an ounce of water; both were exposed to all the influence of the atmosphere except rain—the bean, treated with aërated water, appeared overground nine days sooner than that moistened with distilled water, and produced 25 beans, whereas the other pot produced only 15; the same experiment was made with stock July flowers and other plants with equal success. The manner in which fixed air acts in promoting vegetation seems well explained by Senebier; he first discovered that fresh leaves exposed to the sun in spring water, or water slightly impregnated with fixed air, always produce pure air as long as this impregnation lasts; but as soon as it is exhausted, or if the leaves be placed in water out of which this air has been expelled by boiling, they no longer afford pure air, from whence he infers, *that fixed air is decomposed, its carbonic principle retained by the plant, and its pure air is expelled. It appears to me also, by acting as a stimulant, to help the decomposition of the water.* Hazenfraz, indeed, denies its decomposition; but his arguments do not appear to me conclusive, for reasons too tedious and technical to mention here."

Sir Humphry Davy admits that the presence of fixed air is necessary to preserve health and sustain the vigorous growth of plants, but he seems to consider it more as a necessary sustenance to be taken into the system *by the leaves, than as food by the roots.*

He says, " When a growing plant, the roots of which are supplied with a proper nourishment, is exposed, in the presence of solar light, to a given quantity of atmospheric air,

air, containing its due proportion of carbonic acid, the carbonic acid after a certain time is destroyed, and a certain quantity of oxygen is found in its place; if new quantities of carbonic acid gas be supplied, the same result occurs, *so that the carbon is added to plants, from the air, by the process of vegetation in sunshine, and oxygen is added to the atmosphere.*" He adds, "This circumstance is proved by a number of experiments made by Drs. Priestley, Ingenhouz, and Woodhouse, and M. T. de Saussure, many of which I have repeated with similar results. *The absorption of carbonic acid gas, and the production of oxygen, are performed by the leaf.* And leaves recently separated from the tree, effect the change, when confined in portions of air containing carbonic acid, and absorb carbonic acid and produce oxygen, even when immersed in water holding carbonic acid in solution."

The opinion that fixed air is consumed by plants, seems to be unanimous, and to those who believe in the doctrine of the circulation of the sap, it may appear necessary to support their theory, that the carbonic acid should be absorbed by the leaves. But Kirwan's observations do not lead us to conclude that it is at all necessary that the leaves should possess such powers, and I shall hereafter endeavour more clearly to shew that this is the fact, when treating of the leaves of plants.

List of Patents for Inventions, &c.

(Continued from Page 256.)

Thomas Machell, of Great Ryder-street, in the Parish of St. James, Westminster, Surgeon; for his improved method of applying for medicinal purposes the agency of atmospheric air, liquid, or gaseous substances

stances to the external surface, and to some of the internal cavities and passages of the human body, and for the more convenient and useful mode of employing oil and spirits on similar principles in lamps and other luminous apparatus. Dated August 24, 1818.

JOHN BENNET, of Manchester, Lancashire, Shopkeeper; for certain improvements in filtering vessels, and in the filtering medium thereof. Dated August 31, 1818.

JOSEPH BOWYER, of Kidderminster, Worcester, Carpet Manufacturer; for an improvement in the machinery for making Brussels and cut pile, commonly called Wilton carpeting, figured rugs, and imperial rugs. Dated August 31, 1818.

RICHARD GREEN, of Lisle-street, Leicester-square, Middlesex, Sadler's Ironmonger; for an improvement upon the spring billet for harness, and the application thereof to bridles, heads, and reins, bits, sword-belts, gun-springs, and other purposes. Dated August 31, 1818.

WILLIAM SALISBURY, of Brompton, Middlesex, Botanist; for a machine or implement for the purpose of preparing hemp, flax, and other vegetable fibrous substances; partly communicated to him by a foreigner in the service of his Imperial Majesty the Emperor of Russia, and partly of his own invention. Dated August 31, 1818.

FREDERICK DIZE, of Crabtree, Fulham, Middlesex; for an improvement on musical wind-instruments of a certain description. Dated August 31, 1818.

HENRY STUBBS, of St. James's-street, Westminster, Blind-manufacturer; for a moveable heel for boots, shoes, or other purposes. Dated September 7, 1818.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CXCVIII. SECOND SERIES. Nov. 1818.

Specification of the Patent granted to BENJAMIN TAYLOR, *of Mile Eud, near Glasgow, in the County of Lanark; for a Loom to work by the Power from a Steam Engine, which will weave Figures or Flowers upon either twilled or plain Cloth, in either Silk, Cotton, Linen, or Worsted, or any of them intermixed.* Dated January 31, 1818.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Benjamin Taylor do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is described as follows; that is to say: The loom is worked without any draw boy, and shifts the different lashes required for the changes without stopping; the figures in the different articles being produced by means of barrels, filled with wires arranged to the figures or flowers in a similar manner to that of the barrel organ producing tunes, and the lashes being lifted, and the changes effected, by means of a lever, acting from its centre on both sides of the loom. The

size may be from three to eight feet in breadth, the length only the space occupied by its machinery; the working parts are as follows, references to which are given in the annexed drawings, and the same numbers refer to the same parts in each view of the machine. An iron shaft extends across the loom, on one end of which there are two pullies, as represented in No. 1, (Pl. XIV.) the one fast, the other loose. By these the loom is driven or stopped at pleasure. On the other end of this shaft there is a spur wheel, of eighty six teeth, No. 2, which communicates motion to the fly or lathe, No. 3, by two connecting rods, No. 4, a stud being fixed in the fast pulley, and another in the spur wheel: this, by means of a belt from a drum or pulley applied to the fast pulley, gives motion to the whole. The harness this loom is mounted with differs from any other, and requires to be described with the loom. It has a double neck, and as one lash falls the other rises; and by the falling of the one the weight assists the rising of the other. The necks of the harness is attached to as many upright levers, No. 5, as there are divisions in the harness neck, by threads, No. 6: these levers are acted upon by two cylinders, No. 7, one on each side of the loom, at a proper distance above it. On each cylinder one half the pattern intended to be worked is put on by small wires opposite each lever, and these are taken into two fans No. 8, or large levers, which extend from the neck of the harness to the cylinder on each side of the loom, each turning upon an iron rod within one inch of their centres, being acted upon by two levers, No. 9, above them. At the ends of which levers, next the cylinder, they work upon two studs, about two and an half inches below their centres, and act upon two inclined planes, No. 10, which are fixed upon the end of the fans next to the cylinder; this gives the lift to the harness, when

when standing perpendicular on the top of the inclined plane; same time the other is inclined toward the neck of the harness, a connecting rod, No. 11, being fixed to the top of each lever. To keep them at proper distances, a line is fixed at the centre of the connecting rod, and to a segment of a pulley, No. 12, one point of which is about two and a half inches more from the centre than the other. These work on two studs, fixed so that the top of the pullies are of equal height with the connecting rod: a line is attached to each of these pullies, and also to two treadles or levers, and is put in motion by a wheel, No. 13, of one hundred and twenty teeth, fixed upon a shaft, that goes across the loom; at each end of which there is a segment of a circle, No. 14, which acts upon a treddle or lever, to keep it down while the shuttle passes through eight times across the web, that being one half the revolution of the wheel; it then acts upon the other treddle or lever in the same way, and completes the revolution of the wheel, and at the same time completes two lashes of the flower or pattern. On this shaft also there are two wipers. No. 15, that act upon two treddles or levers, that communicate by a line to a lever, No. 16, fixed upon a stud, which acts upon the cylinder rack wheel, No. 17, turning one tooth for every lash in the flower or figure, making two changes both upon fans and cylinders alternately, and this without stopping the loom. This wheel is driven by one of sixty teeth, No. 18, fixed on another shaft, on which there are eight wipers, No. 19, that act upon eight treddles, which form a satin twill of eight leaves across the web. This wheel is also driven by a pinion of fifteen teeth, No. 20, that is fixed on the end of another shaft, which shaft drives the shuttle on the opposite end; there is a spur wheel, No. 21, of one hundred and seventy-two

Tt 2 teeth,

teeth, working into that of eighty-six teeth, which gives the movement to the whole.

To work cross borders, there is another cylinder applied, with the pattern wired upon it as before described, and only differs in the working of the levers, No. 22: they lay horizontal, and are two feet six inches long, and act upon an iron rod, No. 23, about two inches from their centres: their numbers are equal to the divisions in the neck of the harness, which are fixed by a line to pullies, of about three inches diameter, and another line is fixed to a pulley of about one inch in diameter: these two pullies are fast together, and the neck is lifted by the small one, by the opposite end of the lever from the cylinder, When the cylinder is working it catches the end of the levers required to form the figure by pegs of wood, that project from the cylinder, and keeps up the lash while the shuttle traverses across the webs, when it changes, as before described.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM BUSK, *of Ponsbourn Park, in the County of Herts, Esquire, and* ROBERT HARVEY, *of Epping, in the County of Essex, Victualler; for certain Improvements in the Means or Mode of making Pipes and Tubes of Porcelain Clay, or other ductile Substances.*

Dated December 5, 1817.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, we the said William Busk and Robert Harvey do hereby declare that the nature of our said invention, and

and the manner in which the same is to be performed, are particularly described and ascertained as follows; that is to say: Our improvements in the means or method of making pipes or tubes of porcelain clay, or other ductile substances, consist of, and are effected by, apparatus, of which the pipes or tubes are made or formed in entire cylinders, or such other entire shape may be derived at once. And the apparatus consists of a cylindrical or other conveniently-shaped box or vessel wherein to put the material whereof the pipes or tubes are to be prepared, and which may be fixed or placed upon any convenient frame or carriage, and a piston or follower adapted or fitted to the inside of such cylinder or vessel. The cylinder is open at the end, so as to receive the material for use and admit the piston, and close at the other, except an opening of about the size and form of the pipe or tube proposed to be made. To this opening is applied and fixed, by screw or any other convenient mode, one end of a pipe or tube, (of about the same size or bore as the opening,) which we call a neck. Upon the further end of this pipe, tube, or neck, we fit a second pipe or tube, which we term a cap. This cap is made to fasten on the outside of the former pipe or tube by means of a bayonet ketch, or by some other means, so as to admit of its being readily removed and replaced across the inside of the cap. And nearly home to the part which comes in contact with the first pipe, tube, or neck, we place a narrow bar *a*, Fig. 4, (Plate XV.) into which we fix a small bar or rod *b*, at right angles thereto, which extends along the middle to nearly the opposite end of the cap. And upon the end of this rod or bar, but within the cap, we fix a core or button *c*, of the size and form desired for the internal orifice of the proposed new porcelain or other pipe, placing such core or button so as not

to

to touch the side of the cap any where, but to come flush with the end of the cap.

Fig. 1, (Plate XV.) shews the external appearance of the cylinder or vessel into which the clay or other material is put. A, the pipe, tube, or neck, fixed thereto. This tube may be straight or bent; we in general use it bent, for the purpose of giving a convenient direction to the new pipes: it may be made to take off and change, as convenience shall require.

Fig. 2 represents the external appearance of the cap detached.

Fig. 3, end views of the same, shewing the core or button, with the cross bar bearing the rod that supports the core or button.

Fig. 4 a section of the cylinder, neck, pipe, and cap, with the bar *a*, the rod *b*, and the button *c*. The shape and dimensions of all these different parts of the apparatus may be varied at pleasure, according to the form and size of the pipes required to be made. They may be made of metal or wood, or any other material of sufficient strength, as may be most agreeable. The clay or other material to be used for making the new pipes being put into the cylinder, the piston or follower is then forced into the cylinder or press by hand, or any other ordinary mode of pressure, of sufficient force. The clay or other material is thus become compressed, and is by degrees forced out of the cylinder into the neck, and from thence into the cap, where, passing the bar which is placed across the cap, it comes to the core or button at the outer orifice, and there passing, in a continued substance and course round the core, it comes forth an entire pipe at the ultimate orifice of the cap, of the external size and form of such orifice, and of the internal size and form of the core or button. It is obvious, that the construction of the porcelain

porcelain or other new pipes depend principally upon the placing of the core or button; but we do not mean to confine ourselves strictly to the placing it as above described; but any situation where a similar core or button is adopted in a neck or cap for the like purpose, with the application of pressure as above, we shall consider an infringement of our invention.

In witness whereof, &c.

Specification of the Patent granted to THOMAS HOMFRAY, *of the Hyde, Pinfare, Staffordshire, Ironmaster; for a new Kind of Bobbins, or Bobbin, used in Spinning and other Manufactories.* Dated May 28, 1818.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Homfray do hereby declare that my invention is described as follows; that is to say: I take a piece of sheet iron, of the length and breadth in proportion to the size of the bobbin intended to be made, which I form and braze into a cylinder. I then take four other pieces of sheet iron, and having cut them to the size required, I press them into a square form, and join two of them together, at their respective edges, by turning the edge of one over the other, to form the head of the bobbin; and after the head is so formed, then solder or rivet the same to each end of the cylinder. I then introduce a piece of wood into each head of the bobbin, through which I make a hole, of a proper size, for a spindle, on which the bobbin is to work.

In witness whereof, &c.

Specification

Specification of the Patent granted to MARY SEDGWICK, *of Bishopsgate Within, Starch Manufacturer; for a valuable Product, or valuable Products, from that Part of the Refuse, Slime, or Wash, of Starch, that will not of itself subside.*

Dated February 10, 1818.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Mary Sedgwick do hereby declare, that the nature of my said discovery, and the manner in which the same is to be prepared, are particularly described and ascertained in and by the following description thereof; that is to say: Take the slime, wash, or refuse of starch, obtained in the manufacture of starch from wheat, after the whole of the starch has been taken from it; put it through a fine hair sieve, to take any bran out that may have remained in it; then make a bed of dry sand, about two feet deep, six long, and four over it, with a strong hurden cloth, and pour the wash upon it, about two inches thick; after it has stood three or four days it will be in a state to cut out in pieces. The object of exposing the slime to this action of a bed of dry sand, is to deprive the slime of water, the sand acting like a strainer or filter: when the slime has acquired a sufficient consistency it must be laid upon brick or chalk, for one or two days, and then put into a drying stove. It must be broke in pieces, pounded upon an iron plate, not very hot, and well stirred till the whole of the humidity is evaporated; and, lastly, the plate must be made very hot, gradually. After the preparation has been thus far obtained, let it be exposed to a strong degree of heat, until

until the product acquires a pale almond or chesnut colour, the operator taking care to stir the product continually, to prevent it being burnt or injured by an unequal application of heat. After this has been accomplished, it must be ground and sifted fine for use.

In witness whereof, &c.

Description of improved Optical Instruments.

Communicated by Mr. John Bottomley, *of Scarborough.*

Gentlemen, *Scarborough, Sept.* 17, 1818.

A FEW copies of the subjoined were printed and circulated here at the time of its date. I shall feel obliged by your giving it a place in the Repertory for the next month.

Besides the instruments therein described, I had contrived others, a particular description of which I intend to send you hereafter, together with a more detailed account of those already specified.

I had also contrived concentrators of light, for increasing the illumination of the Kaleidoscope, and for other purposes. One of these is merely a hollow conical reflector, such as are commonly applied to lamps. A patent has lately been obtained for a new mode of using this instrument, but I learn from the patentee's agent here, that the patent mode is the reverse of mine, which is, to present the wider end of the reflector to the light, the other being joined to the Kaleidoscope, or turned towards the object to be illuminated.

It was my intention to avoid addressing you on these matters, until after the completion of some experiments which I have not yet had an opportunity of making; but having recently found myself anticipated in an inven-

tion of importance, and perceiving that I am at present in danger, I think it better to address you thus far without delay.

It is rather late in the month, but I hope you may be able to find room for this short communication. I could not write sooner, for it was not until yesterday that I became acquainted with the patent invention. The patentee was here the day before exhibiting his apparatus.

Your's, &c.

JOHN BOTTOMLEY.

A brief description of the optical instruments I have lately contrived, may not be unacceptable to my friends and to the public.

The first is an inverted, hollow, truncated pyramid, of several sides, lined with reflectors, and furnished with wheels and sliders of various descriptions; particularly with hollow wheels, containing the usual ornaments of the Kaleidoscope, and is designed chiefly to represent a window of painted or stained glass, with unceasing change of pattern, and to several beholders at the same time.

The second is composed of two hollow truncated pyramids joined together at their bases; the third, of a hollow prism joined to the base of a hollow truncated pyramid; and the fourth, of a hollow prism joined to the bases of two hollow truncated pyramids.

These also are lined with reflectors, and are of various angles, proportions, and numbers of sides; and may be used for viewing either opaque or translucent objects. In some cases, multiplying glasses are attached to the instruments.

Scarborough, JOHN BOTTOMLEY.
June 16*th*, 1818.

In

Scarborough, Oct. 10, 1818.

In my letter of the 17th ultimo, I informed you that the danger in which I found myself, of being anticipated in my contrivances for the concentration of light, and of which I was the more sensible in consequence of what I had recently experienced, determined me to address you respecting them without delay.

From the notice on the cover of the Repertory for the present month, I learn that my communication arrived too late for publication therein; and that you wish me to send you a more particular account of my contrivances, in time to be inserted in your next number.

Had I written earlier in the month, I should, as may be inferred from the concluding paragraph of my letter, have been less studious of brevity; but my observations would have been confined to the principal subject of my communication, on which I proceed to enlarge a little.

My mode, already described, of using the hollow conical reflector, whatever it may be in principle, will, I think, appear quite new in practice; and prove exceedingly useful, especially to those who read, write, or work by candle light, or need a concentration of solar light.

The patent apparatus mentioned in my letter, is similar in effect to some instruments of the first class specified in the printed paper of which I sent you a copy. The patent invention relates to light only; but I propose to concentrate both light and heat.

It is obvious that from one source of artificial light or heat, there may, by means of hollow reflecting cylinders, prisms, cones, pyramids, &c. be concentrations in several directions. It is also obvious, that instruments of this description admit of abundant variety of modification and arrangement; and that they may be combined, not

not only one with another, but likewise with plane and other mirrors.

I cannot, on this occasion, enumerate all the various modifications, arrangements, and combinations that have occurred to me: those may form the subject of another communication:—it will be sufficient for the present, to add, that where only one concentration is required, I nearly surround the source of light or heat with reflectors, suited to the nature of the concentration required.

Hoping this communication may arrive in time to be appended to the other, I remain,

Your's, &c.

JOHN BOTTOMLEY.

Description of improved Carriages without Horses, invented by Mr. CHARLES DRAIS.

Communicated in a Letter to the Editors.

GENTLEMEN,

I TAKE the liberty of sending you inclosed an extract from the Morning Chronicle of Sept. 1817, which accidentally attracted my notice a few days ago. I do not recollect to have seen any account in your valuable Repertory of such a Carriage; but perhaps some of your numerous correspondents or readers may be able to give a more accurate description of this apparently useful and interesting contrivance.

Your's, &c.

A CONSTANT READER.

The Carlsruhe Zeitung contains the following:—

"Mr. Charles Drais, who, according to the testimony of credible witnesses, had already, in July last, with one of the latest improved carriages, without horse, invented by

by him, gone from Manheim to the Swiss reley-house, and back again, a distance of four hours journey by the posts, in one short hour; has, with the same machine, ascended the steep hill from Gernsback to Baden, which generally requires two hours, in about an hour, and convinced a number of amateurs, assembled on the occasion, of the great swiftness of this very interesting species of carriage. The principle of the invention is taken from the art of skating, and consists in the simple idea of a seat upon wheels driven forward by the feet acting upon the ground. The fore part *(vorhandene ausfishrung)* in particular, consists of a riding seat upon two double-shoed wheels running after each other, so that they can go upon the footways, which, in summer, are almost always good. To preserve the balance, a little board covered and stuffed is placed before, on which the arms are laid, and in front of which is the little guiding pole, which is held in the hand to direct the route. These machines will answer very well for couriers and other purposes, and even for long journies; they do not weigh 50 pounds, and can be had with travelling pockets, &c. in a very handsome and durable form, for a mere trifle."

A few Facts relative to the Colouring Matters of some Vegetables. By JAMES SMITHSON, *Esq. F.R.S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

I BEGAN, a great many years ago, some researches on the colouring matters of vegetables. From the enquiry being to be prosecuted only at a particular season of the year, the great delicacy of the experiments, and the great care required in them, and consequently the trouble

trouble with which they were attended, very little was done. I have now no idea of pursuing the subject.

In destroying lately the memorandums of the experiments which had been made, a few scattered facts were met with, which seemed deserving of being preserved. They are here offered, in hopes that they will induce some other person to give extension to an investigation interesting to chemistry and to the art of dying.

Turnsol.

M. Fourcroy has advanced, somewhere, that turnsol is essentially of a red colour; and that it is made blue by an addition of carbonate of soda to it; and he says that he has extracted this salt from the turnsol of the shops.

If turnsol contained carbonate of soda, its infusions should precipitate earths and metals from acids.

I did not find an infusion of turnsol in water to have the least effect on solutions of muriate of lime, nitrate of lead, muriate of platina, or oxalate of potash.

Its tinctures, or infusions, consequently, contain neither any alkali, nor any lime; nor probably any acid, either loose or combined. This is unfavourable to the opinion of urine being employed in the preparation of turnsol.

I put a little sulphuric acid into a tincture of turnsol, then added chalk, and heated; and the blue colour was restored. It appears, therefore, that the natural colour of turnsol is not red, but blue, since it is such when neither disengaged acid or alkali is present.

No addition of chalk brought the cold liquor back to a blue colour; the carbonic acid absorbed by it, during the effervescence of the carbonate of lime, being sufficient to keep it red.

Some turnsol was put into distilled vinegar. An effervescence

vescence arose; and after some time the acid become neutralized. On examining the mixture with a glass, there were seen, at the bottom of the vessel, a multitude of grains like sand. It was found on trial that these grains were carbonate of lime; probably of slightly calcined Carrara marble.

When turnsol is treated with water till this no longer acquires any colour whatever, the remaining insoluble matter is nearly as blue as at first.

Acids made this blue insoluble matter red, but did not extract any red tincture.

Carbonate of soda did not affect it.

If the vegetable part of this blue residuum is burned away, or it is washed off with water, a portion of smalt is obtained.

On exhaling, on a water bath, a tincture of turnsol, the colouring matter is left in a dry state.

This matter heated in a platina spoon over a candle, tumefied considerably, as much as starch does, became black and smoked, but did not readily inflame, nor did it burn away till the blowpipe was applied. It then burned pretty readily, leaving a large quantity of a white saline matter. This saline matter saturated by nitric acid afforded crystals of nitrate of potash, and some minute crystals like hydrous sulphate of lime.

Is this potash merely that portion of this matter which exists in all vegetable substances? or is the colouring matter of turnsol a compound, analogous to ulmin, of a vegetable principle and potash? Its low combustibility gives some sanction to this idea.

Of the Colouring Matter of the Violet.

The violet is well known to be coloured by a blue matter which acids change to red; and alkalies and their carbonates first to green and then to yellow.

This

This same matter is the tinging principle of many other vegetables: of some, in its blue state; of others, made red by an acid.

If the petals of the red rose are triturated with a little water and carbonate of lime, a blue liquor is obtained. Alkalis, and soluble carbonates of alkalis, render this blue liquor green; and acids restore its red colour.

The colouring matter of the violet exists in the petals of red clover, the red tips of those of the common daisy of the fields, of the blue hyacinth, the holly-hock, lavender, in the inner leaves of the artichoke, and in numerous other flowers. It likewise, made red by an acid, colours the skin of several plumbs, and, I think, of the scarlet geranium, and of the pomegranate tree.

The red cabbage, and the rind of the long radish, are also coloured by this principle. It is remarkable that these, on being merely bruised, become blue; and give a blue infusion with water. It is probable that the reddening acid in these cases is the carbonic; and which, on the rupture of the vessels which enclose it, escapes into the atmosphere.

Of Sugar-loaf Paper.

This paper has been employed by Bergman as a chemical instrument. I am ignorant of what it is coloured with.

Sulphuric, muriatic, nitric, phosphoric, and oxalic acids make it red. Tartaric and citric acids, made rather yellow spots than red ones. Distilled vinegar, and acid of amber, had nó effect on it.

Carbonate of soda and caustic potash did not alter the blue colour of this paper.

Water boiled on this paper acquired a vinous red colour; carbonate of lime put into this red liquor, did not affect

affect its colour: nor did carbonate of soda or caustic potash change it to blue or green.

Cold dilute sulphuric acid extracted a strong yellow tincture from this boiled paper: carbonate of lime put to this yellow tincture made it blue; but on filtering, the liquor which passed was of a dirty greenish colour; and sulphuric acid did not make it red: a blue matter was left on the filter, which was not made red by acetous acid; but was so by sulphuric.

After this treatment the paper remained brown; seemingly such as it was before being dyed blue.

It should seem that there are at least two colouring matters in this paper; one red, which is extricable from it by water; the other blue, which requires the agency of an acid to extract it.

Its insolubility in water, and low degree of sensibility to acids, distinguish the blue matter from turnsol; to which its not being affected by alkalis otherwise much approximate it. Its easy solubility in dilute sulphuric acid, and being reddened by it and several other acids, show it not to be indigo.

Of the Black Mulberry.

The expressed juice of this fruit is of a fine red colour.

Caustic potash made it green, which gradually became yellow.

Carbonate of soda did not make it green, but only blue.

Carbonate of ammonia changed it to a vinous red, rather than to blue; and this redness increased on standing.

Caustic ammonia made it bluer than its carbonate; but, on standing, the mixture became of the same vinous red.

The mulberry juice mixed with carbonate of lime became purple. On filtering, a red liquor passed; and the carbonate of lime left on the filter was blue. An addition

 of

of whitening to the red filtered liquor did not alter its colour; nor did this second portion of whitening become blue. Heating did not affect the red colour of this liquor; so that it was not owing to carbonic acid, disengaged from the carbonate of lime. Caustic potash instantly made this red liquor a fine green, and gradually yellow.

Sulphuric acid rendered all the above mixtures florid red. It is remarkable that the mixtures with ammonia, and carbonate of ammonia, which were become quite vinous red by standing, were made a perfect blue by the sulphuric acid before they were reddened by it. It would hence seem that the red colour, caused by these alkalis, was owing to an excess of them; and that in a less quantity they would have produced a blue.

The filter, into which the mixture of mulberry juice and chalk had been thrown, was become tinged blue. Water did not remove this colour. Sulphuric acid made this paper florid red. Caustic potash did not alter its blue colour; but put on the places made red by sulphuric acid, it restored the blue colour, but did not produce green.

Future experiments must decide whether this blue matter is the same as that of turnsol; or as the blue matter which the experiments above have indicated in sugar-loaf paper.

The juices of many other fruits, as black cherries, red currants, the skin of the berries of the buckthorn, elder berries, privet berries, &c., seem to be made only blue by mild fixed alkalis, but green by caustic. Puzzling anomalies, however, occasionally present themselves, which seem to show a near relation between the several blue colouring matters of vegetables, and their easy transition into one another.

The

The Corn Poppy.

The petals of the common red poppy of the fields rubbed on paper stain it of a reddish purple colour.

Solution of carbonate of soda put to this stain occasioned but little change in it.

Caustic potash made it green.

Caustic ammonia seemed not to have more effect on it than carbonate of soda.

Some poppy petals being bruised in a mixture of water and marine acid, formed a florid red solution: a superabundance of chalk added to this red liquor, did not make it blue; but turned it to a dark red colour exactly like port wine.

Some poppy petals bruised in a weak solution of carbonate of soda, and the mixture filtered, the liquor which came through was not at all blue, but of a dark red colour like port wine. Caustic potash made this red liquor green, which finally became yellow.

Some dried poppy petals of the shops, gave a strong obscure vinous tincture to cold water. This red tincture beated with whitening, did not alter to blue, but preserved its red colour.

These very imperfect experiments may perhaps suggest the idea, that the colouring matter of this flower is the same as the red colouring matter of the mulberry.

Of Sap Green.

The inspissated juice of the ripe, or semi-ripe, berries of the buckthorn, constitute the pigment called sap green; by the French, vert de vessie. This species of green matter is entirely different from the common green matter of vegetables.

It is soluble in water.

Carbonate of soda and caustic potash changed the solution of sap green to yellow. Paper tinged by sap green is a sensible test of alkalis.

Sulphuric, nitric, and marine acid, made it red. Carbonate of lime added to a reddened solution, restored the green colour, which therefore appears to be the proper colour of the substance.

The green colour, which the last infusions of galls present, appears to be different, both from the usual green of vegetables, and from sap green.

Some Animal Greens.

A green puceron, or aphis, being crushed on white paper, emitted a green juice, which was immediately made yellow by carbonate of potash (wrongly called subcarbonate.)

There are small gnats of a green colour: crushed on paper, they make a green stain, which is permanent. Neither muriatic acid nor carbonate of soda altered this green colour. It is consequently of a different nature from the foregoing.

On planting 212 *Acres with* 965,300 *Forest Trees. By* J. Lawson, *Esq. of Old Mill, near Elgin.*

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The Gold Medal was voted to Mr. Lawson *for this Communication.*

In June, 1813, I purchased a small property, called Chappletown, situated in the parish of Drumblade, in the inland part of Aberdeenshire, and consisting of 242 acres, arable; 80 of green pasture; and 246 acres, two roods,

roods, of hill and moor ground; in all, 568 acres and a half, Scotch measure.

Finding the greater part of the moor of a dry gravelly soil, I resolved to plant what was called the hill, with larch and Scotch firs; and in the autumn of 1813 I agreed with Mr. Alexander Rennie, nurseryman at Aberdeen, for planting it accordingly, and contracted also for having it inclosed with a turf fence, which was executed in a substantial manner, and stands well.

The extent of the hill is 200 odd acres, twelve of which being peat moss, were unfit for planting; the remainder, 191 acres, three roods, thirteen furlongs, were planted in spring, 1814, with two year old seedling larch and Scotch fir, in nearly equal quantities; and the inner side of the fence was filled up in the autumn of that year with larger larches.

The plantation has all been completely filled up, where deficient, during the year 1816, and the whole appears be in a very thriving state, though in a cold exposed situation.

I have also filled up a small plantation of twenty-one acres, which had been made some years before I purchased the estate, with transplanted larches, which are all doing well.

A considerable proportion of both the arable and pasture land being wet, and even marshy, I resolved to drain the whole as completely as possible, and accordingly, since 1813, I have laid out about 200*l.* upon drains, which have proved of great advantage. For the drains made on the boundaries of the estate I have charged the tenants nothing, and only 5 per cent. per annum on the amount of the expense of the field drains; by which they are great gainers, the benefit they derive being fully equal to from 15 to 20 per cent. per annum, during their

leases.

leases. I also am a gainer, as the tenants are now better able than formerly to pay their rents, and my property is considerably improved.

I have expended upon this estate, since Whit Sunday, 1813,

	£.	s.	d.
For planting	235	2	10¼
— Fence to protect it	77	16	8
— Drains	202	14	9½
— Roads	53	17	7
	£.569	11	11

being full 20s. per acre on the whole extent, arable, pasture, hill, and moor.

Certificates.

Robert Gordon, Merchant, of Drumblade, certified that what is within stated by John Lawson, Esq. relative to planting and draining the lands of Chappletown, in this parish, is strictly true: and that these improvements have added greatly to the beauty, as well as value, of the estate.

Alexander Rennie, nurseryman and seedsman in Aberdeen, deposed before Francis Gordon, Justice of the Peace, Aberdeenshire, that having been employed in the year 1813 by John Lawson, Esq. of Chappletown, in the parish of Drumblade, and county of Aberdeen, to plant for him a moor, or hill, which he accomplished within the period given, *viz.* December 1, 1813, to April 1, 1814, by planting thereon 380,000 larches, and 384,000 Scotch firs, all two years old seedlings; and 5,000 large larches on the inside of a dyke, inclosing the 191 acres above mentioned, all within the foresaid period: he farther deposed, that in October, 1815, he filled up the vacant spaces

spaces of the foresaid plantation with 120,000 Scoth firs, 57,000 larches, and, for the dyke sides, 300 large larches: that in October, 1816, he filled an older plantation, of twenty-one acres, with 5,000 large larches, 15,000 transplanted Scotch firs, and 1000 large beeches, that the whole is now in a very thriving condition, and well fenced with a peat dyke and ditch, the surface water being properly carried off.

I send enclosed a statement made out by Alexander Rennie, of what trees he planted for me at Chappletown, by which you will see, that in October, 1816, he put into the plantation 18,000 Scotch firs, which had been omitted in his affidavit, to which I had annexed the pencil marks, showing the numbers planted in the whole, including 80,000, by Mr. Milne, the former proprietor. Respecting the ground, it is a dry, gravelly soil, upon which there grew short heath, and on which small sized sheep used to procure a scanty subsistence, but by no means of much value; so little so, that the tenant had given up keeping any of them on the moor, and did not object to its being planted. From the thinness of the soil, and the dryness of the ground, I considered it very fit for planting, as the moor was too gravelly and too much exposed for improving; besides, the distance both from the sea and lime would have made the expense of improving more than it could ever have repaid. Upon the whole, I considered planting the only proper use to be made of it, and, from its present appearance, I have every expectation of being amply repaid in the end: should the wood thrive, it must prove valuable from there being few plantations of Forest Trees in that part of the country.

Old Mill, March 24, 1817. JOHN LAWSON.

Planted

Planted for John Lawson, Esq. between Dec. 1, 1813, and April 1, 1814, 191 acres, 13 furlongs, with 380,000 larch, and 384,000 Scotch firs, all two years old seedlings; also 5,000 large larch in the back of the dyke: also, in October, 1815, I filled up the said plantation with 120,000 Scotch firs, and 57,000 larch, and 300 large larch for the dyke sides; and in October, 1816, 18,000 Scotch firs; also, for the other twenty-one acres, I have sent 5,000 large larches, 1,500 transplanted Scotch firs, and 1,000 large beeches.

(Signed) ALEXANDER RENNIE.

*** The pencil marks, to which Mr. Lawson alludes in the foregoing letter, stand thus:

Larch.	Scotch Firs.	Beech.		
380,000	384,000	1,000	Larch	447,300
5,000	120,000		Scotch firs	537,000
57,000	18,000		Beech	1,000
300	15,000		Planted by J. Lawson	985,300
5,000				
447,300	537,000		Planted formerly by Mr. Milne	*80,000
			Planted upon Chappletown	1,065,300

* Which appeared to have been half larch and half Scotch firs.

Method

Method of preparing an Extract of Sprats. By Mr. Thomas Stiles, *of Norwich.*

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The Silver Medal and Ten Guineas were voted to Mr. Stiles *for this Communication.*

THE attention shown in the case of my method of curing herrings in 1813, induces me to lay before the Society an invention which, after much labour, has been crowned with success. I have submitted it to the inspection of competent judges, one of whom is industriously communicating the utility of it to the circle of his acquaintance. My friend, William Spratt, Esq. of the city of Norwich, will have the honour of presenting a sample of essence, liquid and solid, prepared from my cured fish, These articles can be produced in any quantities, should the public receive them with the same avidity as the individuals within the circle of my acquaintance. It is equally suitable for foreign and home consumption, being so highly charged with preservatives as to warrant its keeping in any climate. I need not enlarge on the utility of this invention as the article will plead my cause. The essence herewith sent is prepared from fish of my curing in November, 1813, which are now as bright as they were on the day of pickling, of which I have several cwt. now by me.

The process by which Mr. Stiles makes his liquid and solid essence of sprats is as follows:

He commences by salting and curing any quantity of sprats, according to the method described in the thirty-first volume of the Transactions of the Society. He then

pours the sprats with their liquor into a copper, and brings them to a boiling heat; after which they are put into hair bags, and strongly pressed. The liquor thus obtained is put into a vat, or any other convenient vessel, for a few days, till the oil has risen to the surface; the oil is to be removed very carefully, and the remaining liquor (called by Mr. Stiles Essence) will be found to be wholly free from the coarse peculiar flavour of the sprat, and to be scarcely distinguishable from the essence of anchovy.

In order to prepare the solid essence, he takes a quantity of wheaten flour, and carefully dries it in a water bath for the space of sixty hours; the lumps being then broken to pieces, he mixes it well, by hand, with the liquid essence, till the mass is about the consistence of cream, adding at the same time a little bole armenic to give it a red colour. He then reduces the mass by farther evaporation in a water bath, stirring it constantly with a wooden spatula till it has acquired the consistence of butter; the preparation is then compleat, and is packed in barrels for sale.

Description of a Curvagraph.

By Mr. W. Warcup, *of Dartford, Kent.*

With an Engraving.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The Silver Medal and Ten Guineas were voted to Mr. W. Warcup *for this Communication.*

I BEG leave to lay before the Society of Arts, &c. an instrument of my invention for describing *curve lines,* which I purpose calling the *Curvagraph.*

It

It is not in my power to mention the various purposes to which this instrument may be applied, as I have hitherto used it only in mechanical and ship drawing, the several curves of which may be drawn and constructed much more easily and expeditiously by means of this, than by any other method at present in use.

To naval draftsmen, I presume, it will be a valuable acquisition, as it will supersede the tedious operations they have recourse to, when they have no mould that will answer their intended curve, and it will enable them to copy drawings with the greatest accuracy and ease.

CERTIFICATES.

I do certify that the Curvagraph, invented by Mr. Warcup, has proved to be a very useful and valuable instrument in delineating geometrical drawings of machinery, and that by the aid of that instrument much time has been saved in the course of Mr. Warcup's employment upon a long series of drawings made by that gentleman under my direction.

Chelsea, Feb. 15, 1817. M. I. BRUNEL.

Understanding that Mr. Warcup has submitted to the Society of Arts his ingenious instrument and invention, the Curvagraph, allow me to say that I consider it an original invention, and one of considerable utility in engineering; but especially so in naval architecture, as it will not only much facilitate the forming of naval drawings, but avoid, in a great degree, the necessity of the present practice of using moulds, and the cause of great delay and expense.

8, *Oxford Street, March* 12, 1817. GEORGE DODD.

I do hereby certify, that having examined the Curvagraph invented by Mr. Warcup, I am fully convinced that it is admirably adapted to promote dispatch when making copies of drawings, and evinces much ingenuity in its construction.

Deptford Yard, Feb. 25, 1817. W. STONE.

I hereby certify, that the Curvagraph invented by Mr. Warcup has been used under my observation, with very great advantage in ship drawing, and I have no doubt but in drawing curve lines generally, much valuable time may be saved by the use of this instrument, and it is far preferable, in my opinion, to any thing that has hitherto been offered for such a purpose. I beg to recommend it as possessing a considerable degree of merit and ingenuity.

Lambeth, March 5, 1817. HENRY MAUDSLAY.

REFERENCE TO THE ENGRAVING.

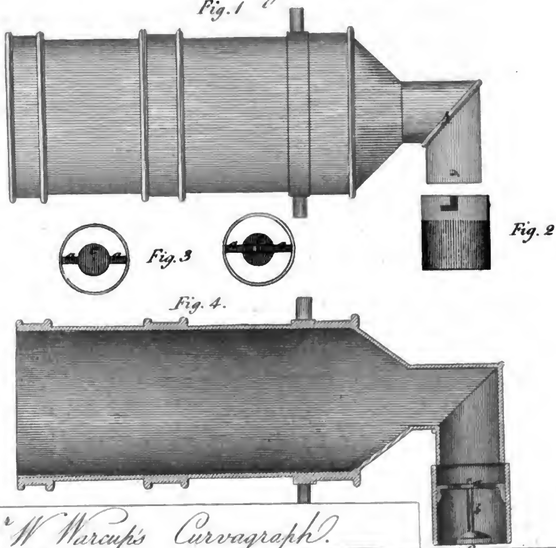
Fig. 1, (Plate XV.) A A, a plain slip of whalebone, forming the ruler. B B, graduated ribs, at right angles to the ruler, with which they are connected by small joints of brass, Figs. 2 and 3. C C, a beam, consisting of a case of whalebone, containing slips of cork, or of any other elastic material, and perforated, to allow the ribs to pass through.

Fig. 4, a section of the same. D D, bolts, consisting of two pieces of wood or of ivory; by the pressure of which against the elastic slips of cork the ribs are either kept in their place or released at pleasure.

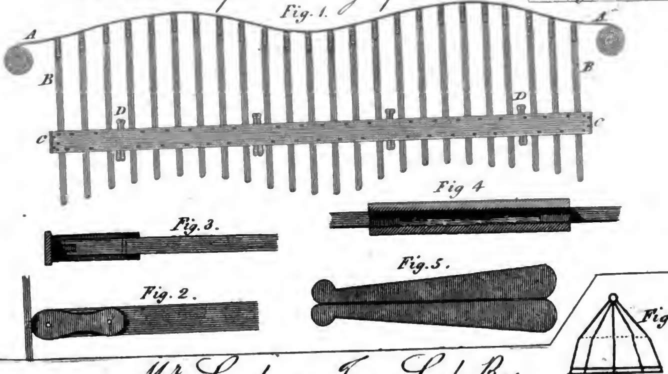
Fig. 5, the bolts on a larger scale.

On

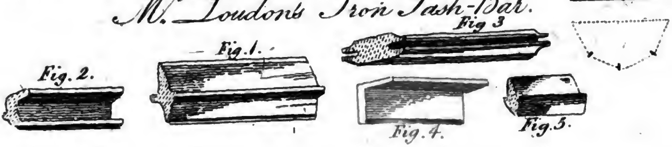
Busk & Harvey's Patent.



Mr. W Warcup's Curvagraph.



Mr. Loudon's Iron Sash-Bar.



On Curvilinear Hothouses; with a Description of the various Purposes in Horticultural and general Architecture, to which a solid Iron Sash Bar (lately invented) is applicable. By J. C. Loudon, *F.L.S., H.S., &c.*

With an Engraving.

THE defective construction of hothouses, both in respect to the beauty of their form, and the admission of light, has long been acknowledged; the former by men of taste, and the latter by enlightened horticulturists. Can any building be more offensive to the eye than those lean-to shed-looking glass roofs, which, though they cover what may justly be termed scenes of the greatest luxury, are yet, from their external deformity, by the general consent of mankind deemed only fit to be concealed in the kitchen-garden? Ought not such scenes as exhibit the various fruits and flowers of the torrid zone, and support the gaiety and beauty of spring and summer amidst the frigid scenes of winter, to be appended to the mansion, or at least appropriated to the more elegant parts of a residence? It is true, numerous attempts have been made to do this in those architectural conservatories so frequently joined to mansions; and to render them tolerable for this purpose, the *shed-like* appearance has been disguised by stone piers and parapet walls. But the construction of such buildings is radically bad; for in proportion as they are dignified by architectural forms, in the same ratio will the plants to be inclosed suffer from the want of the light excluded by the masonry. The state of plants which have passed the winter in such conservatories proves this. Can that edifice then be in correct taste, whose architecture is at variance with its use? which,

which, as it is rendered more beautiful, becomes less useful?

That the forms of edifices may be beautiful without exhibiting any of the orders of Grecian or of Gothic architecture, it is presumed the present age is too enlightened and liberal to deny. "The sublimity or beauty of forms," observes Mr. Alison, "arises altogether from the associations we connect with them, or the qualities of which they are expressive to us." May not therefore glass roofs be rendered expressive of ideas of a higher and more appropriate kind, than those which are suggested by mere sheds, or a glazed arcade? Imagine, instead of a row of glazed sheds, a row of detached sections of spherical bodies, of an almost perfect transparence — the genial climate and highly coloured productions within, obtaining during the whole day the unobstructed influence of the sun's rays, and the construction of the edifice combining the greatest strength and durability—what will be the expression?—Instead of the usual conservatories attached to mansions, imagine a lofty arched roof wholly transparent, and joined to it, according to the magnitude and style of the mansion, globular projections, elevated circular towers surmounted by Eastern domes of glass, or other beautiful or characteristic forms, all transparent and of permanent duration. Will not this substitution of new forms and almost perfect transparence be an improvement, gratifying both to the man of taste and the horticulturist? —The invention to be treated of in this paper—by admitting the greatest beauty and variety of form, with the greatest possible admission of light, added to a degree of durability limited only by that of one of the strongest of British metals—will effectually contribute to this desirable end.

It may be stated as a remarkable fact in regard to that more common class of hothouses called forcing-houses, that no improvement whatever has been made in their external form since their introduction into this country about 120 years ago. "Internally," as Mr. Knight has observed, "two are hardly ever constructed alike, though intended for the same purpose;" which shows, 1st, that utility has been much more studied than beauty; and 2dly, that no great progress has been attained even in regard to utility; because where that is the case a certain degree of unanimity is the result. "That form," adds Mr. Knight, "which admits the greatest quantity of light through the least breadth of glass, and which affords the greatest regular heat with the least expenditure of fuel, must generally be the best; and if the truth of this position be admitted, it will be very easy to prove that few of our forcing-houses are at present even moderately well constructed."

An attentive examination of the improvements made by this philosophic horticulturist, as well as of the writings of Sir Joseph Banks, Mr. Williams, Sir George Mackenzie, and others, on this subject; added to the experience derived from 15 years exertions as a horticultural architect, including during that period an inspection of all the principal hothouses in Great Britain and on the continent of Europe, has enabled the author of these Hints to propose such improvements in hothouses as will meet every idea of beauty, variety, or elegance of form, and satisfy the most sanguine expectations in respect to durability, and the admission of light. The fundamental source of both these improvements is a solid iron sash-bar of great strength and elegance, and which admits of being bent in every direction without diminishing, but rather increasing, its strength. This bar was

first

first described to the public in "*Remarks on the Construction of Hothouses, &c.*" published in 1817, shortly after it was invented; and it is here intended to set forth more fully its various uses, and render it generally known and easily obtainable by the public. In the work above alluded to, in which a general view is taken of the state of hothouse architecture both in Britain and on the continent, from personal inspection,—it is stated that an "*Arrangement will shortly be put in activity in London, in which every improvement hinted at in that work, and all future improvements as they may come into notice, will constantly be attended to; and when of due value rendered available to the public as articles of trade.*"

This contemplated arrangement is now completed: what relates to the contrivance of plans and their erection in the country, being under the guidance of the author of these Sketches; and what relates to the manufacture of the newly invented bar and the other materials, being carried on by Messrs W. and D. Bailey, 272, High Holborn.

The leading advantages which a solid wrought-iron sash bar or astragal possesses not only over wooden ones, but over every other species of bars hitherto used, either for windows, skylights, or hothouses, are the following, viz.

1st, They admit of being bent in every direction without diminishing their strength; hence in glasscases or hothouses they admit of every possible variety and beauty of shape.

2d, They may be made of any required magnitude; and this without the use of rafters, but merely by the position and curve of the bar; or in some cases by an increase in its dimensions.

3d, They admit of more light. The best-constructed wooden

wooden hothouse roofs, such as those lately erected by Mr. Aiton in the royal kitchen-garden at Kensington, render 1-3d of the roof opaque; the best metallic sashes and iron rafters from 1-4th to 1-6th; but these not more than 1-10th, the panes of glass being supposed of the same size in the three cases.

4th, They are of greater durability, and occasion less breakage of glass. Iron bars composed of two parts, as fillets inserted in a grooved bead or astragal, are liable to be corroded by moisture, when they separate, and break the glass. Copper, tin, and iron, and all compound bars in this way soon have their parts separated by oxydization in the grooves of junction. But these are solid, and therefore not liable to the same process of destruction. They can merely rust on the surface when the coating of tin or paint decays.

5th, With all these advantages they are *less expensive than copper or any other iron or metallic bar whatever;* in some cases coming cheaper than wood, and in general cases not exceeding the price of a hothouse roof formed of rafters and bars of that material.

These bars are applicable, with advantages superior to all other bars, to every description of common hothouse or hotbed sashes; which may either be entirely formed of this article, using Fig. 2, (Plate XV.) as styles, or wooden frames may be fitted in with it at less expense than with any other material equally durable.—To every description of hand glass or portable glass case;—to skylights, for which it possesses the great requisite of abundant strength, and of course they may be made curved and with less rise and diminished superficial contents than heretofore;—to shop fronts, windows of warehouses, depôts, barracks, hospitals, churches, theatres, poor-houses, common dwelling-houses, and the bed-

 rooms,

rooms, servants' rooms, and the windows of all offices domestic or agricultural, of mansions; and in general to every building where strength, (viz. a high degree of tenacity and hardness, not mere brittle hardness and a little tenacity, as in the use of cast-iron or stone); lightness in appearance, permanency, and security against fire and thieves,—are desirable objects. They are not recommended for the living-rooms of elegant mansions, where great intricacy of moulding (particularly ogees or quirks) is reckoned an elegance: because such mouldings cannot be produced by the simple machinery used in manufacturing these œconomical bars:—mahogany, wainscot, hollow copper, brass, or Eldorado metal, are allowed to be much more suitable for these purposes.

There are yet two other purposes to which they are particularly applicable; viz. as rafters for sheet iron or copper roofs, either for houses, very extensive buildings, or virandas; and one variety of the bar, viz. Fig. 3 entire, and produced in halves longitudinally, may be advantageously applied for the styles and frame-work of doors and window-shutters, the pannels of which being filled in with plate iron inserted in the grooves, a very œconomical resource is thus provided for fitting up fire-proof rooms or entire buildings, at the same time proof against thieves, and of great durability.

For greater detail as to the advantages of iron sash bars in hothouses, see Mr. Knight and Sir G. Mackenzie in the "Horticultural Transactions for 1817 and 1818," and the article "Horticulture" in the Edinburgh Encyclopedia, published 1817.

There are ten distinct species of bar, five of which are represented by Figs. 1 to 5. The others differ from these chiefly in regard to magnitude and mouldings. Each sash bar and the style, Fig. 6, may, by

by a simple change in the machinery, be manufactured in halves, thus producing in all above twenty varieties. When bent or worked to the form in which they are to be applied, they may be tinned so as to prevent their rusting for many years, even independently of the use of paint.

On the mechanical Structure of Iron developed by Solution, and on the Combinations of Silex in Cast Iron.

By J. F. DANIELL, *Esq. F. R. S. and M. R. I.*

From the JOURNAL of SCIENCE and the ARTS, Edited at the ROYAL INSTITUTION.

(Concluded from Page 301.)

AGAIN, to collect the results as we proceed—50 grs. were employed, of which 23.8 were unacted upon. The 26.2 furnish us with,

8.0	oxyd of iron.
5.8	silex.
12.4	loss.
26.2	

To ascertain the nature of this loss, which, from previous experiments, is probably carbon, the following experiments were undertaken.

10 grs. were accurately mixed and triturated in a mortar, with 400 grs. of oxymuriate of potash. This mixture was put into an apparatus composed of part of a gun barrel, closed at one end, and furnished with a flexible metallic tube at the other, which dipped into the first of a series of Woulfe's bottles charged with lime water. A strong red heat was applied to the barrel, and the car-

 bonic

bonic acid produced precipitated the lime in the bottles, the last of which remained perfectly clear and undisturbed. The precipitate was carefully collected and dried; it weighed 38.8 grs.

Now, 100 parts of carbonate of lime contain 44 carbonic acid, therefore 100.0 : 44.0 : : 38.8 : 17, and 100 carbonic acid contain 28.6 of carbon, and 100.0 : 28.6 : : 17.0 : 4.8.

But in the barrel, 0.8 grs. were found to have been unacted upon. Therefore, 9.2 of the carburet contains 4.8 of carbon.

If we now apply this to the preceding experiment, we shall find that there is an excess in the products.

For 9.2 : 4.8 : : 26.2 : 13.6,

which gives the result—

8.0 oxyd of iron.
5.8 silex.
13.6 carbon.

27.4
26.2

1.2 excess.

Of this excess in the products, we shall consider the cause hereafter.

I shall proceed at present to relate another experiment which remarkably confirms the results of the others, though by a totally different method.

28.5 grs. of the carburet were mixed with 500 grs. of pure soda, and placed in an iron tube, similarly prepared to that in the last experiment. It was gradually heated to redness, and when gas began to be given off, the flexible pipe was adapted to it, and passed under the surface of lime water, in a Woulfe's bottle, communicating with the

the pneumatic trough. The heat was raised to a bright red, and continued for two hours. The gaseous products were collected in a bell glass, having passed through the lime water without producing any milkiness. The gas collected amounted to 56 cubic inches.

When the gas had ceased to come over, the apparatus was allowed to cool, and the contents of the barrel washed out. The solution was passed through the filter, and the substance remaining upon it, washed and dried, weighed 13.5. It was digested in muriatic acid, again washed and dried, and weighed 6.5. It was the carburet unaltered. The loss of weight was owing to oxyd of iron, as shewn by the examination of the muriatic solution.

The sodaic solution was put into a gas bottle, fitted with an acid holder, and communicating with a mercurial gasometer. Muriatic acid was allowed to mix gradually with it, and 39 cubic inches of carbonic acid were thus collected. The solution was then evaporated to dryness. The silex being washed and heated to redness, weighed 4.9.

The gas which had been collected was next examined.

It burned with a yellow flame. When sulphur was sublimed in it, carbon was deposited, and when exploded with chlorine, fuliginous matter lined the tube.

A cubic inch of the gas was mixed with two cubic inches of oxygen, in an exhausted tube, and fired with an electrical spark, lime water was admitted and agitated. Carbonate of lime was formed, and the absorption was $\frac{25}{10}$. The residue consisted of oxygen, and varied in different experiments, from $\frac{5}{10}$ to $\frac{6}{10}$ of a cubic inch. When the oxygen was decreased in this proportion, the absorption was within $\frac{1}{10}$ of being total; and this small residue was probably owing to a little atmospheric air.

Now,

Now, as pure carburetted hydrogen condenses just double its bulk of oxygen, it follows that a little hydrogen was mixed with this gas, and an average of the experiments would make the mixture 50 cubic inches of carburetted hydrogen, and 6 inches of hydrogen.

Of 28.5 grs. of the carburet employed, 6.5 were recovered unaltered. 22 grs. were therefore decomposed, 39 cubic inches of carbonic acid weigh 18.3, and contain 5.0 of carbon, and 50 cubic inches of carburetted hydrogen weigh 8.5, and contain 6.2 of carbon *.

The analysis therefore stands thus :—

7.0	oxyd of iron.
4.9	silex.
11.2	carbon.
23.1	
22.	
1.1	excess.

Considering the complication of these experiments, and the difference in the method of operating, their agreement is nearer than could well have been expected.

The excess in the products is no doubt owing to the oxygenation of one or more of them in the process. The iron, as it is obtained in the results, is in the state of red oxyd. If we suppose that it exists in the double carburet in the metalline state, there would be a deficiency instead of an excess. For 7.0 red oxyd of iron, is only equal to 4.8 of the metal, and thus the result would be—

* These calculations are made from Davy's Elements. The barometer, at the time of the experiment, was 29.74, and the thermometer 55°. I have not made the calculation for the mean pressure and temperature, the difference being so small.

4.8 iron,

4.8	iron.
4.9	silex.
11.2	carbon.
20.9	
1.1	deficiency.
22.0	

I am inclined, from all circumstances, to believe, that the triple carburet, as it is first obtained, consists of iron and silicum, in the metalline state, united to carbon. When brought into contact with oxygen gas, the metals become converted to protoxides, giving out heat, without separating from the carbon; and when decomposed at a red heat by soda, they become oxygenated to the utmost, at the expense of the water which is still found in the alkali at that temperature.

Red oxd. iron 7.0=6.2	black oxd.
4.9	silex.
11.2	carbon.
22.3	
22.	
.3	surplus,

arising from the oxygenation of the silex?

This idea is further confirmed by the following experiment. 3 grs. of the double carburet, perfectly pure, were placed in a glass tube, with one gr. of potassium. The air was exhausted, and the tube heated to redness. It was then allowed to become perfectly cool. When the air was admitted, the ingredients became instantly red hot. Upon washing the products, the carburet was obtained unaltered.

The following comparative experiments mark a distinctive

tive difference between this body and some others, and confirm the general results.

Plumbago and potassium, heated in the same way in vacuo, did not heat upon the admission of the air.

Lamp black and potassium did not heat. Plumbago, in an ignited stream of mixed oxygen and hydrogen, burnt away, and left a red ash.

The double carburet, burnt in the same way, left a white ash.

Carbon collected from the solution of steel in an acid, possessed no metallic lustre, and ignited at the flame of a common candle, burning like tinder. The carburet was not affected by any heat short of that of the blow pipe.

I wish, in conclusion, to draw attention to certain analogies which subsist between these experiments, and others performed by more able hands, for the purpose of establishing the existence and properties of silicum.

Sir H. Davy, in his Elements of Chemical Philosophy, says, "When potassium is brought in contact with silica, ignited to whiteness, a compound is formed, consisting of silica and potassa; and black particles, not unlike plumbago, are found diffused through the compound.

"From some experiments I made, I am inclined to believe that these particles are conductors of electricity; they have little action upon water, unless it contain an acid, when they slowly dissolve with effervescence; they burn when strongly heated, and become converted into a white substance, having the characters of silica."

When it is considered that most of the potassium, which is prepared for experiment, however well it may be cleaned, contains no inconsiderable portion of carbon, is it improbable that these particles, not unlike plumbago, may have been a carburet of silicum? Its little attrac-

tion

tion for the oxygen of water, agrees very well with the phenomena which we have just been considering.

Professor Berzelius, and M. Fred. Stromeyer, have succeeded in producing a compound, which they consider as a combination of iron, silicum, and carbon. Their method was to select very pure iron, silex, and charcoal. These they made into a paste, with gum or linseed oil, and heated them very intensely, in a covered crucible. Their reasons for supposing that silicum, in the metallic state, existed in the product, were these: That the iron and silex extracted from the alloy, when taken together, very sensibly exceeded the weight of the alloy examined; that the alloy gave a much greater quantity of hydrogen, with muriatic acid, than the iron alone which it contained would have given; and that there is no known combination of a metal with an earth, which requires the successive operation of the most powerful agents to decompose it as this alloy did. The colour of this compound was that of common steel.

The quantities of the component parts, however, of this alloy, differed very materially from those of the purified carburet obtained from cast iron. They varied from 85.3 of iron, 9.2 of silicum, and 5.3 of carbon, to 96.1 of iron, 2.2 of silicum, and 1.6 of carbon. They were likewise highly magnetic, (owing no doubt to the great quantity of iron), which the triple carburet is not*.

I have stated, that the quantity of the silex and triple carburet yielded by the iron which I employed, rather decreased in the interior of the mass. Towards the latter end of my experiments, I estimated the relative proportions. The iron was dissolved in muriatic acid, and

* See Phil. Mag. No. 173, translated from the Swedish original; and Ann. Chim. tom. 81, from Gottingen Trans.

 the

the insoluble residue, after it had absorbed its dose of oxygen, was digested in muriatic acid. These solutions were precipitated by ammonia, evaporated to dryness, and exposed to a strong heat. The residue was boiled to dryness, with a little nitric acid, and again heated. The quantity of red oxyd of iron thus obtained, amounted to 738 grs. which are equal to about 513 grs. of metallic iron.

The quantity of the gray mixture of silex and double carburet, amounted to 93 grs.

The mean results of all the experiments stand thus—

1000 grs. of the gray cast iron,

yield 846.6 iron.

153.4	consisting of silex	104.3
1000.0	double carburet	49.1
		153.4

100 grs. of the double carburet of iron and silex, upon an average of five experiments, gave the following results—

Red oxyd of iron	31.2=	28.0 black oxyd.
Silex .	22.3=	20.6 oxyd of silicum?
Carbon .	51.4=	51.4 carbon.
	104.9=	100.0

Although the existence of silicum in the metallic state, alloyed with iron, is not actually proved by the foregoing experiments, yet the probability of such a compound, I conceive, is greatly increased by them. Indeed, reasoning from analogy alone, it is hardly possible that ten per cent. of silex, could exist in union with the metals in any other manner. When we look to the result of intensely heating the oxyds of the alkaline metals, in contact

tact with iron, it would be surprising if the earthy oxyds could resist decomposition, in the long continued and intense heat of the iron furnaces.

The process of puddling is almost evidently dependent upon the same supposition. The oxydation of the metals of the earths, is more likely to produce the heaving and internal motion of the iron in that process, than the mere burning away of carbon; and the sudden visible spontaneous increase of temperature, can hardly be explained upon any other principle. I have examined the slag or black oxyd, which is pressed out from the iron by rolling, after it has undergone this operation. I extracted the greater part of the black oxyd of iron which is combined with it, by muriatic acid; the matter which was left was a complete glass, composed of above 80 per cent. of silex with lime. There was no trace of carbon. Such a result is exactly consonant with this idea of the process.

Much remains still to be done, to complete our knowledge of the nature of cast iron. Notwithstanding the numerous experiments which have been made upon it, we remain in comparative ignorance of its composition. Guided by the new lights which the science of chemistry has lately acquired, an accurate revision of the subject could not fail to repay those who have an opportunity of tracing the changes of the metal in the various stages of its manufacture.

On the Roots of Plants.

From the SCIENCE of HORTICULTURE, &c.

By JOSEPH HAYWARD, *Gent.*

THE root is the commencement and foundation of trees: by what particular power it is impelled forward into the earth, is of trifling importance to the practical gardener; and whether it may be accounted for on the principles of gravitation or attraction, it is not necessary for my present purpose to determine: it is progressive in its growth, similar to the branches, but in an inverted direction. As the branches of a tree are formed by a very tender and succulent point pushing upwards into the air, so the root penetrates downwards into the earth; but as it has to make its way through the pores, or between the particles composing the soil it is planted in, which is often close and adhesive, its first projecting points are wisely adapted to the purpose, by being much more minute and compliable, which enables it to advance almost as readily as water. After a root has effected a passage, it is endowed with considerable expansive and repulsive powers, and thereby enabled to make its way, by pushing off, on all sides, the encumbering soil; when the soil is but partially submissive, the root accommodates itself to the cavity admitting its increase, however rugged and irregular.

Roots are, notwithstanding, impatient of resistance, and at all times evince a partiality for that soil which is most accommodating, and run most evenly and luxuriantly where they meet with the least resistance and the greatest support.

The office of the root is to collect and apply the food, which forms and determines the growth of the plant and tree;

tree; and the constitution and habit of the roots determine those of the branches. If the roots grow luxuriantly, the branches will also; and the reverse.

From hence it must be concluded, that in planting trees, two essential objects present themselves for our consideration: first, to ascertain the soil best adapted to afford a sufficient and accommodating body, bed or space for the roots to repose and range freely in, and induce and support such habits as are most desired; and next, that it contains or will admit the application of a supply of food, of a proper quality, and in due quantity. And to determine this, due attention must also be paid to the situation or elevation of the roots, in comparison with the surface of the soil. In a deep tenacious soil or clay, roots can only find a free passage through fissures or clefts which are formed by its occasional contraction. And as these openings are not very close together or numerous, the roots do not divide much or become fibrous; but those which strike into them, range wide and deep, and getting beyond the general influence of the sun and air, collect their food or sap from a source ill adapted to fructification; and consequently such trees are generally found to be of a cold, aqueous, and unprolific nature.

On the contrary, when a soil is light, porous, and shallow, the roots, meeting no obstruction, divide and form a great number of fibrils, which ranging horizontally, and being more exposed to the effect of the sun and air, incline a tree more to become fructiferous, than to an increase of wood or an extension of branches. And in such a situation, the greatest supply of food being appropriated to the production of fruit, the tree grows but little in size.

It is remarked by Hitt, on this part of the subject: "I have made observations on the productions of most kinds of

of soil, and found the most healthy old peach and nectarine trees growing on a brown-coloured loam, with a rock about a foot from the surface of the borders. From this I conclude, that it will be a good method to lay a floor of broad stones or planks under the roots of fruit trees, where there is not a natural rock, which will prevent the roots from sinking too much below the surface; for the tap or downright roots may produce vigorous shoots, yet they are but seldom well furnished with blossom buds. When all the roots of a tree are near the surface of the borders it blossoms best, being well furnished with small branches, which are not so subject to suffer by the honey dews as thicker ones."

Mr. Knight, in his Treatise on the Apple and Pear, says, "The strongest and most highly-flavoured liquor which has hitherto been obtained from the apple, is produced by a soil which consists of a shallow loam on a lime-stone basis."

Miller, speaking of fruit trees, says, "And it sometimes happens that the roots of trees are buried too deep in the ground, which, in a cold or moist soil, is one of the greatest disadvantages that can attend tender fruits; for the sap, which is contained in the branches, being by the warmth of the air put strongly into motion early in the spring, is exhausted in nourishing the blossoms, and a part of it perspired through the wood branches, so that its strength is lost before the warmth can reach to the shoots, to put them into an equal motion in search of fresh nourishment to supply the expense of the branches, for want of which the blossoms fall off and decay. And the shoots seem to be at a stand, until the further advance of the warmth do penetrate to the roots, and set them in motion, when suddenly after, the trees, which before looked weak and decaying, do make prodigious progress in their shoots,

shoots, and before the summer is spent, are furnished with much stronger branches than those trees which have the full advantage of sun and showers, and that are more fruitful and healthy; which must be certainly owing to the former observations, as also to their drawing in a great quantity of crude moisture, which, although productive of food, is yet unkindly for fruit."

He also says, " Some authors who treat of the qualities of the earth, say that it ought to be of the same quality, three or four feet deep, for trees, which, if they have not that depth, will languish and decay after they have been planted six years. But this is not true in fact: for most trees will thrive very well if they have two feet depth of good earth, especially fruit trees, which produce the most generous fruits when their roots spread near the surface of the earth."

Whether we consider the effects here stated to be produced by the roots being kept more within the influence of the sun and air, or by the peculiar nature of the food supplied by the soil in that situation, it operates in support of one and the same principle, *viz.* that it is necessary the roots should be kept near the surface; for whether that which supplies the food of plants be a red, a black, or a brown loam, or sand or clay, the proper quality of food to induce fructification, and produce the highest flavoured fruits, can only be furnished within a certain depth from the surface, or within the proper influence of the sun and air.

Mrs. Ibbotson has given a theory which directly opposes those practical observations and conclusions. When speaking of the roots of plants, she says, " The endeavours I have made to collect facts sufficient to prepare myself to give an exact account of the laws by which the root is regulated, the powers which govern it in its exercise

cise as well as interior form, the parts which compose, and the mechanism which moves it, has at length given me courage sufficient to venture on my task, and if I do not thoroughly satisfy my readers, I shall still shew many things perfectly unknown, and at a further time, I shall hope to add circumstances that may render it more complete and more worthy the attention of the public; at least I can promise that I shall advance nothing bnt what all may ascertain the truth of, nor enter into any detail that may not be proved to be just and true, by those who will take the trouble of seeking both in dissection *and practical gardening*, that knowledge which constant labour and watching has procured me."

I certainly do not possess the powers of examination, or perhaps of dissection, to justify any criticisms on Mrs. Ibbotson's representations *of what she has seen;* but as the connection, application, and use of the different parts, as seen and described by her, are in a great measure conjectural, I may, perhaps, without presumption, venture to offer a few remarks *on her opinion* of the process of nature. She says, "It is the tap root which always forms the leading shoot of the tree, and if it is cut, it will without doubt spoil that part, by forming two middle stems to the tree, at least I have generally found this to be the case; and as the beauty of the tree depends much on the perpendicular height of its single pillar, the custom they have in most nurseries of curtailing the tap root is a most vicious one."

She also says, "What is the use of the tap root? by shooting perpendicularly down to fix the tree firmly to the ground and keep it straight in that position."

This appears to me a conjecture, neither supported by the observations of nature, or the principles of science.

What

What person possessing the least knowledge of mechanics, could ever expect that a pole, with any substance fixed at its top, exposing a large surface to the winds, could remain straight in its perpendicular position when set in the earth, without horizontal fixtures? Indeed the elm, one of the tallest growing trees, is seldom if ever found with a tap root, but is supported straight in its perpendicular position wholly by horizontal or lateral roots. The authoress proceeds, " Thus it is surrounded by radicals which perpetually pump up from every different soil as it proceeds in depth, what other roots cannot attain, matter, which mixed with what the higher grounds bestow, serves to bring a variety to compound the different ingredients required for the various nourishment of the tree; probably minerals are wanted to form the juices of the bark; and I doubt not that the deep descent of the tap root is most necessary to the health and vigour of the tree. How improper then is the custom of cutting it, and curtailing also many of the other roots, each of which has its appropriate branch, which will of course suffer in decay, for the dilapidations produced by the ignorance of the gardener. But the loss of the tap root can never be remedied; it can no longer serve as a deep well to gain not only a quantity of moisture from the number of rills it may meet with in its descent, but also matter from a variety of soil, and innumerable productions it passes in its way. The tap root then is only like the radicals, only a large pump to collect and throw up all that it can select of water and other juices; the second part of the root, (which she describes to be the place where the root joins the trunk,) is the reservoir for collecting the materials; and the third part is the laboratory for forming each different gas and juice necessary for the health and habits of the tree; I may well add a

 fourth,

fourth, for the radicals are the collectors sent out on every side to seek fresh provisions, to augment the stores, and increase the riches of this little habitation."

Again, "That a tap root or any root that is injured, should be cut off, there can be no doubt, since the danger of the rot is greater than any other inconveniencies; but the greatest care, when trees are to be transplanted, should be taken not to hurt the roots, and if any radical can be preserved by wrapping them up in fresh earth, it should be done, for if they will live a little time, it will be a great gain to the tree; and here is the advantage of having the pit ready dug, and removing the plant with all the earth round it, it preserves the few radicals alive, and enables them directly to perform their office of pumping moisture and nourishment from the earth. But if the tree is taken out some hours before it is replaced, all the radicals are sure to die. And if the tap root also is injured, no wonder they never make fine trees, or that those planted by nature are always found superior. The reason that throwing a quantity of water into the pit has been found serviceable is, that it supplies moisture and quickens the growth of the new radicals, and what is still more advantageous, and should be constantly done, a large barrow of good mould should be thrown on the roots and about the radicals; for a young and tender root, if it has to pierce through the clods of earth in its sickly state, will certainly fail."

These observations, as they respect trees in their native soil and climate, may generally apply; but when it is considered that the business and art of a nurseryman and gardener is to render the nature and habits of trees as subservient as possible to every variety of soil and situation, and the experience and observation of all shew that the tap root is prejudicial to fructification, I cannot but

but think that the terms "*ignorant and vicious*," as they respect the general operation of cutting off or changing the course of the tap root in young plants, and particularly of fruit trees, are ill applied; but when attached to the too general practice of breaking off and reducing the roots on every transplanting, neither those or any other words can be too severe.

That a tap root or any other root is peculiarly adapted to supply any particular branch or part of a tree, I very much doubt; but should this be the original arrangement in the system of nature, experience proves that it is not an invariable law, for if a part of the branches of a tree be lopped off, the sap which those would have consumed, is given to the remaining branches, and they are proportionally increased. Whenever part of the root is taken off, it does not affect any particular branch, but the whole of the branches are equally affected by the privation and loss; and although cutting off the tap root may, by lessening the supply of moisture, produce the same effect as an extended surface of branches, and incline a tree to vary the vertical growth of its branches at an earlier period, yet it is proved in every nursery-ground that all young plants of erect growing trees, are inclined to form their strongest branches in a perpendicular position, and if not obstructed, to throw out its whole strength into one stem, until it attains a height proportioned to its nature and supply of food, and this even after the tap root is removed.

The effect intended of pouring water into the pit on transplanting, as here explained, is undoubtedly desirable, but it will seldom be produced by such means.

A great quantity of water poured on will often cement or encrust the earth, and render it so close and adhesive, that it will obstruct the emission of fresh radicals, or the

progress of the old ones, and the plant in consequence will be much injured.

Water in those cases should be applied a little at a time and often; this will afford sufficient moisture, and keep the soil loose.

Mould may be a good thing thrown into the pit in the quantity here mentioned, about the roots of forest trees when planted, but it must be improper for fruit trees, for by retaining a large portion of moisture, it will oppose fructification, and endanger their health, or by affording a luxuriant supply of food, the roots may be made to increase rapidly in size, but form few in number. A few large roots running deep and spreading wide, may be necessary to produce a large timber tree, but it would be prejudicial to a fruit tree, for, as before observed, those trees are always more prolific when the roots are much divided or fibrous, and kept near the surface of the soil.

Arrangement of Chemical Principles and Practical Deductions.

From the SCIENCE of HORTICULTURE, &c.

By JOSEPH HAYWARD, *Gent.*

ALTHOUGH this subject has engaged the attention of so many eminent philosophers, none of them appear to have established a theory, that will generally accord with actual observation, or from which we can form a scientific arrangement of practical rules; but the following elementary principles, which are generally admitted, enable us to trace effects, ascertain causes, and to draw conclusions, that will be found applicable to every existing case or positive result.

All

All things that constitute animated nature, are reducible to the same primitive or elementary principles, *viz.* oxygen, hydrogen, nitrogen, carbon and earth. The three first are permanent elastic fluids, the fourth a permanent substance; and although the earths are proved by Sir Humphry Davy, to be compounds of highly inflammable metals and oxygen, it does not appear that they are found in any other state, than as such compounds, in vegetables or animals, nor that it is necessary they should be further subdivided, either for the reproduction, or sustenance, of vegetables or animals. I shall therefore take the liberty, in the arrangement of my system, to consider the earths as elementary principles.

Oxygen is the vital air of life, the principle of combustion, and the vehicle of heat, the pure air of Kirwan.

Hydrogen is the basis of inflammable air, and is the lightest of all ponderable things, the inflammable air of Kirwan.

Nitrogen, or azote, is the opposite of oxygen, and is incapable of supporting combustion and animal life.

Carbon is the basis of common charcoal, divested of all its impurities.

Atmospheric air is compounded of the two different permanent substances, oxygen and nitrogen, in certain proportions, rendered aërial by the expansive power of heat.

Water is composed or formed of hydrogen and oxygen in certain proportions, and in its common state, always holds a portion of earth in a state of solution, and generally of carbon also.

Vegetable substances are reducible to oxygen, nitrogen, carbon, and earth.

Animal substances are reducible to oxygen, hydrogen, nitrogen, carbon, and earth.

With

With these elementary principles in view, tracing the composition and decomposition of animals and vegetables, it will clearly appear, that matter, in the general composition and continuation of the world, is indestructible, and as far as we are enabled to comprehend, that the animal and vegetable parts are continued and sustained by transmutation, and that the general process of nature is to create or compose, by destroying or decomposing.

Thus animals forming the superior part of the creation, are endowed with the powers of destroying, masticating, digesting, and decomposing the substance of both animals and vegetables.

Vegetables, which are more delicately formed, seem peculiarly designed to act in unison with animals, in continuing the animated world, by bringing the divided substances again into action and union.

Animals devour both animals and vegetables to support themselves, and by this, they are at the same time made instrumental in preparing the food of plants, by the decomposition of both animals and vegetables.

From the peculiar organization of vegetables, their food can only be taken up in a state of liquid, and water is the only vehicle by which it can be administered.

Whatever, therefore, constitutes the grand invigorating or accumulating principle in the food of plants, must be reducible to a soluble state, or be held in solution. Although water, in its pure state, contains hydrogen and oxygen only, as it is necessarily brought in contact with, or made to pass through, animal and vegetable substances, which are always scattered over the surface or contained in the soil, before it can come within reach of the roots, it dissolves and carries with it the carbonaceous and earthy matter.

Plants

Plants possess the power of decomposing water, and in the composition of their own various substances, of retaining and applying the carbon, hydrogen, and earth, and a portion of oxygen, and at the same time of emitting the superfluous oxygen as excrementitious.

Animals by respiration, decompose the atmospheric air, retaining the oxygen, and emitting the nitrogen.

Animals and vegetables, when deprived of life and left to spontaneous decay, are decomposed by fermentation, and by this process, carbon and earth are deposited, and oxygen, which is increased by absorption or attraction, is disposed of, by part forming carbonic oxyd, and part carbonic acid gas; the hydrogen and nitrogen are emitted as simple gas, or united as ammonia.

Carbonic acid gas, or fixed air, is formed by a certain portion of carbon being dissolved and held in solution or combination by oxygen, and is more ponderous than atmospheric air.

These elements, being thus separated, are again combined by the various processes of nature.

By the combustion of electricity, the oxygen gas, emitted by vegetables, and the hydrogen gas by putrescent animal and vegetable matter, are united and form water.

By natural affinity, oxygen gas is combined with the nitrogen gas thrown up by the respiration of animals, and atmospheric air formed.

Carbonic acid gas, from its density, is readily brought in contact with calcareous, carbonaceous, and metallic substances, and also with water, and by these absorbed or decomposed.

On the Advantage of Warming and Ventilating Houses, Mines, Ships, &c.

By the Marquis de CHABANNES.

With a Plate.

Extracted from his Pamphlet on that Subject.

THE general means employed, and effect produced, having been explained by reference to various applications of the principle, I shall pause a little on the advantage of warming and ventilating houses.

It has been my constant remark, and I now submit it to the opinion of all who have travelled on the Continent during the winter, that a person suffers more in England from cold and damp, than in any other country situated in the same latitude, or even further North,—and from what cause? Certainly not from economy—for more money is here laid out, to be any thing but warm, than elsewhere to guard against cold: not from the construction of the houses, for these are small and compact, the staircase well closed, and on that account infinitely better calculated to protect them from cold. It must then either be through ignorance, neglect, or prejudice, that they are not the most comfortable in Europe, with regard to the regulation of the temperature in them. One fact is certain, that air enters our apartments from the staircase—the fire in the grate attracts the air, and we are consequently betwixt a reflection of heat, more or less intense, and a current of cold air. This may be easily verified, by placing a thermometer before, and another behind, when sitting before a large fire. The generally considered luxury of sitting round a fire is, therefore, one of the most dangerous situations in the room, and many a cold or stiff neck is caught, for which the uncertainty

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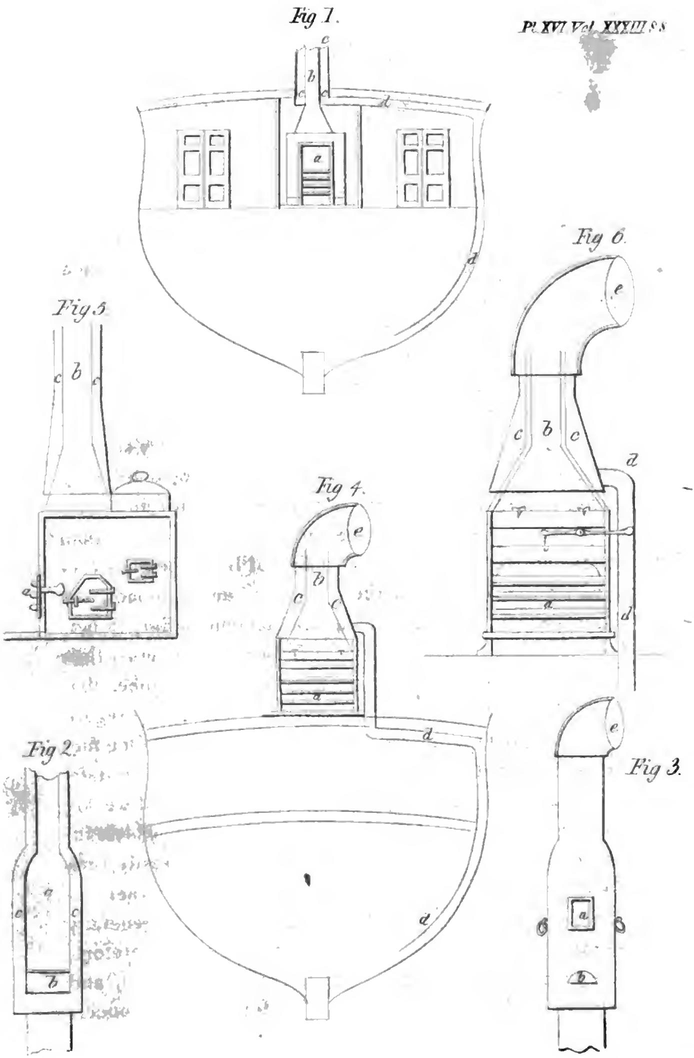

tainty of the climate and inclemency of the season are blamed, while it is our own fault, for not attending to this essentially necessary point. It is not so much when we go out, that there exists any danger. According to the weather, we defend ourselves with shawls, great coats, &c.; besides, our bodies are in motion. But on our return home, with more or less perspiration, we take off these upper garments, we remain inactive, our pores are open, the current of air strikes upon us—perspiration is stopped, and we experience some times, alas! too late, the fatal effects of our own imprudence. It is obvious, that if the air from the staircase was warmed, the evil would be remedied.

On the Continent, an anti-chamber, which is constantly heated, precedes each apartment, and for that reason they suffer less from cold, although in winter the climate may be far more severe. All Englishmen who have travelled must have observed this fact. Many on their return have had their staircases warmed. Why is not this precaution generally taken? It would cause rather a saving in fuel, as much less fire would be requisite in the apartments above. Many, through the false opinion, that if a house is warmed there is more danger of taking cold in going out, argue thus: "We do not wish to be warm: our climate is not so cold, and we need not take the same precautions." If the winter season is less cold in England, it is more wet, which is certainly the more dangerous of the two. Its effects may be seen on walls, papers, furniture, and even in our beds. Is it not necessary to have mattrasses and bed clothes aired if the bed chamber has been a few days uninhabited? Is not damp a much greater enemy to health, and indeed to all our comforts and moveables, than cold; and is it not, therefore, the interest of every one to guard against it? Damp proceeds

from water with which the air is charged. If the walls and furniture of an apartment are in a degree of temperature above that of the external atmosphere, the air retains this water, and carries it off: but if they are in a lower temperature than the outward air, then the air discharges itself of a portion of that water, every thing becomes damp, falls into decay, and perishes. The defect is evident, the remedy more or less known. There is, however, another prejudice to be overcome: that warm air is unwholesome, that it is oppressive. To answer to these two objections it should be observed, that heated air can only be unwholesome, when it is burnt or decomposed. It can only be oppressive for want of ventilation. In proportion as air is heated, its spring expands, and it will fill a greater space than when at a colder temperature. If at that time there is no fire lighted in the room, nor any opening above by which the same quantity is drawn off that enters the apartment, it may seem oppressive to delicate lungs, because its spring is compressed; but it only becomes unwholesome when it has been breathed, decomposed, and deprived of that portion of oxygen, which, in order to be pure, it must possess.

It is an error to believe that air is vitiated because it has passed through heated pipes. It is only decomposed when it is ignited, and the smell which is sometimes perceived arises not from the decomposition of the air, but from the millions of particles floating in it, such as are seen in the rays of the sun, when darting into a room, and which burn when in contact with red hot metals. Even supposing that a red heat absorbs part of the oxygen, this part is so small that it would be difficult to verify it. This assertion I submit to the consideration of men of science.

It is more than probable, that if the prejudice against warm

warm or heated air were traced to its source, it would be found to have originated with persons interested in following the old plan, and whose indolence or incapacity render them constant enemies to any improvement, however important, in an established system; and to the influence which the opinions of such persons have upon others.

Forced ventilation not only purifies the air in our habitations, but is the only means by which the temperature can be easily regulated, all currents of air destroyed, and damps prevented. In England it will be greatly beneficial; but on the Continent, and especially in northern countries, where rooms have no chimnies, its happy tendencies will be still more highly appreciated.

The state of calm existing in sleeping apartments during the night causes a stagnation of air, from which it follows, that so soon as we have decomposed a certain portion we continue to breathe that air again and again, to the great prejudice of our health. It rises perpendicularly as we breathe, and regaining its gravity as it cools, descends, and is again inhaled, deprived of its purity and vital qualities.

May we not also indulge the supposition, that the heaviness of the atmosphere around us is an occasional cause of restlessness and disturbed sleep, that it has some effect on our minds in sleep, and that to the want of ventilation may be attributed, in some measure, a variety of unpleasant sensations. We frequently sleep for hours, and yet rise unrefreshed, with our minds unfit either for the avocations or the pleasures of the day: Is it too bold an assertion, that if there had been a forced evaporation of all air unfit for respiration, our bodies and minds would

have gained that repose, the want of which renders sleep unpleasant and insalubrious? All these sensations may certainly at times be traced to obvious causes, but how frequently is it that we are totally at a loss how to account for not having rested well. In this case I venture to assign it to the want of ventilation, and a proper circulation of air in our apartment; and as a remedy for such inconvenience I recommend my patent lamp.

I have thought of this as a simple method for ventilating bed rooms. This lamp may be adapted in various forms, and of greater or less power. In the specification of my patent I have stated it to extend to every possible means of ventilating by any sort of lamp or other forcing power.

Ventilating Mines, &c.

The chief object of the ventilation of mines is to draw off the heavy air from the lower part, and to replace it continually by fresh air. Amongst the methods at present employed I shall notice two which appear to me the best. The first is by lighting fires below, which causes air to ascend, and fresh air to come down to replace it; but the constant danger of explosion, from the fire, renders this method extremely dangerous. To obviate this, I propose to establish, at the opening of the mine above, a furnace on the same plan as that erected in the lower gallery of Covent Garden Theatre, only of different dimensions, and to draw the air from the lower part of the mine desired to be ventilated, by pipes either of wood, earth, metal, or leather, as convenient, provided they are hermetically joined, and that these pipes, from the different parts of the mine, communicate with those in the furnace. By this means, the heavy air below, being confined

confined in those pipes, will ascend, and will be replaced by fresh air from above.

The second method used, is a mechanical air-pump, at the opening of the mine, which draws up a quantity of air from the mine. The defect of this is, that it only acts upon the upper part of the mine, and that the innermost recesses below do not receive an adequate benefit from it. If to this power separate conductors were brought from those parts of the mine at present experiencing no benefit from its operation, every part must immediately be supplied with fresh air, and the mine would be perfectly ventilated.

If a renewal of air is advantageous in mines, if useful in our apartments, according to their size and the number of persons in them, if indispensable in hospitals, prisons, &c. is it not still more so in confined vessels at sea? The care taken, by the English particularly, to expose their mattrasses to the open air in the day time, to keep the port-holes open whenever the weather will permit, to force air between decks by means of windsails, and, in short, all the precautions which are taken to air as much as possible the different cabins, sufficiently prove how much ventilation is desired. A continual renewal of air may prevent many diseases among the ship's crew, preserve their health and strength, and must, I am convinced, interest the feelings of all Englishmen. Inspired with this hope, and convinced that the mode of ventilation I am about to describe will be attended with these happy results, I hasten to renounce, in regard to this object, all exclusive right under my patent, authorizing every individual to employ the principle in the way which shall appear to him the most advantageous. It consists in

in making use of rarefaction, produced by the kitchen or cabin fire, to draw off the foul air from those parts of the vessel where the admission of fresh air is most desired. The principle is incontestable, its execution is simple, and the effect to be produced certain.

Plate XVI. will sufficiently shew its application, for it to be understood and acted upon.

Description of Plate XVI.

Fig. 1. *Section of a vessel shewing the fire-place in a cabin.—a.* Fire-place. *b.* Tube to carry off smoke. *c.* Double tube, in which the rarefaction is procured, and by means of a pipe *d,* carried down the side of the ship to any part where ventilation is required, drawing the foul air up, and consequently procures a constant renewal of fresh air.

Figs. 2 *and* 3. *Small portative stove, which is made so as to fit to the top of the cabin stove for the purpose of effecting ventilation when there is no fire in the cabin, in which case the tube b, in* Fig. 1, *is shut up.—a.* Fireplace. *b.* Ash-hole. *c.* Outer tube in which the rarefaction is caused and replaces the effect described in Fig. 1.

Figs. 4, 5, and 6. *Front and side view of the kitchen, and of the place in which it is most commonly fixed.* — *a.* Fire-place. *b.* Tube to evaporate the smoke from the fire. *c.* Double box of plate or cast iron, in which the rarefaction is caused by the heat in the tube *b,* and, by means of a pipe *d,* carried down the side of the ship to any part where ventilation is required, draws the foul air up, and consequently procures a renewal of fresh air. *e,* cowl by which the smoke and foul air evaporates.

On

On the Use of Straw Ropes in protecting Fruit-tree Blossom, &c. from late Frosts.

By Mr. James Laird, *Gardener at Portmore.*

From the Transactions of the Caledonian Horticultural Society.

HAVING observed that the Caledonian Horticultural Society are desirous of being informed of the best mode of protecting the blossom of fruit trees on walls, I have taken the liberty of submitting the following method for your consideration, which I have practised with much success for a number of years; and if you think it of sufficient importance, I request you will be so good as lay it before the Society.

As soon as the buds of the trees become turgid, I place poles against the wall, in front of the trees, at from four to six feet asunder; thrusting their lower ends into the earth, about a foot from the wall, and fastening them at the top with a strong nail, either to the wall or coping. I then procure a quantity of straw or hay ropes, and begin at the top of one of the outer poles, making fast the end, and pass the rope from pole to pole, taking a round turn upon each, until I reach the end; when, after securing the end well, I begin about eighteen inches below, and return in the same manner to the other end, and so on, till I have reached to within eighteen inches or two feet of the ground.

The above method is both cheap, and, so far as I have experienced, very efficacious; and as it does not much interrupt the rays of the sun, it may be applied early, and allowed to remain till the middle or end of May, according to the state of the weather.

The first season I tried the above method was in 1802. I had covered a peach-tree, on a wall where were many others. On the 5th of May there was a heavy fall of snow,

snow, and on the morning of the 6th the thermometer stood at two degrees and a half below the freezing point. The consequence was the loss of the whole crop, except a few that were protected by the foliage. But the tree that was covered and protected, produced a fine crop.

I have also fonnd straw-ropes to be very useful in protecting other early crops from the effects of frost, as peas, potatoes, or kidney-beans, by fixing them along the rows with pins driven into the ground.

I have also sometimes used old herring-nets, and at other times branches of evergreens, for the protecting of blossom; but I have not found any of them so efficacious as the above. Besides, straw-ropes are much cheaper, and may be obtained in every situation.

List of Patents for Inventions, &c.

(Continued from Page 320.)

THOMAS PARKER the younger, of Seven Oaks, Kent, Bricklayer; for his method or methods of regulating and improving the draught of chimnies. Dated Oct. 5, 1818.

WILLIAM FINCH, of Birmingham, Warwickshire, Gentleman; for certain improvements in bridles for horses, which he intends to denominate the "Philanthropic Bridles." Dated October 12, 1818.

SAMUEL HOBDAY, of Birmingham, Warwickshire, Snuffer-maker; for an improved method or principle in the making of snuffers without any spring or lever. Dated October 12, 1818.

Sir WILLIAM CONGREVE, of Cecil-street, Westminster, Baronet; for certain new methods of constructing steam-engines. Dated October 19, 1818.

END OF THE THIRTY-THIRD VOLUME.

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